

AD-A127 049

PROGRAM MANAGER: THE JOURNAL OF THE DEFENSE SYSTEMS
MANAGEMENT COLLEGE VOLUME XII NUMBER 2 MARCH-APRIL 1983
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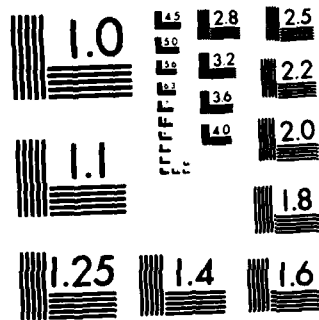
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Program Manager

March-April 1983

The Journal of the Defense Systems Management College

AD A 127 049

The New DepSecDef
Comments on
His New Role

The PM Shop:
Who Really Runs
the Show?

What Does the
Defense Contractor
Really Want?



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Program Manager (ISSN 0199-7114) is published bimonthly by the Defense Systems Management College, Fort Belvoir, Va. 22060, and is intended to be a vehicle for the transmission of information on policies, trends, events, and current thinking affecting program management and defense systems acquisition.

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POSTMASTER: Send address changes to Editor-in-Chief, *Program Manager*, Defense Systems Management College, Fort Belvoir, Va. 22060.

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DepSecDef Thayer Comments on Systems Acquisition from a New Perspective

In his first public presentation after confirmation, the new Deputy Secretary of Defense gives a glimpse of the issues he will emphasize during his tenure.

Recently confirmed Deputy Secretary of Defense Paul Thayer was keynote speaker at the opening convocation for Program Management Course 83-1 on January 25. This article is based on his remarks.

I'm only 2 weeks old as Deputy Secretary, and I'm beginning to look at our defense establishment from the inside instead of the outside. I have been more than a casual observer from the outside for more than 30 years now, and after 2 weeks I can certainly tell that from the inside it does look different. It's going to take me another few weeks, maybe months, before I start putting all these things together that I'm getting firehosed with now. But if I retain 50 or 75 percent of what I'm hearing, then I think within another few weeks I should be up to speed and be able to start making a contribution. In the meantime, I'm trying to keep my mouth shut as much as possible.

Telling Our Story

The Department of Defense is being hammered from all sides, as you all know. There are lots of reasons for it. For one thing, I don't think we have told our story as well as we should have. I think that's fairly obvious. It's very clear that around the country a lot of public support that was there a year ago is eroding. It's eroding because a lot of knowledgeable people, people who are still very strong supporters of defense and very strong supporters of being No. 1 in the world and not No. 2, don't feel that the Department of Defense is managing its affairs very well. They don't understand why the budget is as large as it is. They don't understand that some of the areas of the world that they're told are sensitive really are sensitive, and can affect the best interests of the United States.

Program Manager



They don't understand all the treaties we're committed to around the world. So the story has not been told well.

The fact is, there are a lot of people, in and outside of the Department of Defense, who feel there are better ways to spend our defense dollars. Unfortunately, most of our mistakes are headlined and repeated often around the country. Meanwhile, we are criticized by armchair quarterbacks, by those who pose as defense experts, and by many others who don't pose as anything, but who just love to be critical. There have been, I believe, some things

that have happened in the past couple of years that have improved the acquisition process. But, harking back to what I said earlier, these have not been publicized very well.

The Carlucci Initiatives

I know you all are probably familiar with the Carlucci Initiatives. These initiatives, of which there are 32, were laid out quite a while ago, and they certainly have provided some guideposts for us to follow as we try to clean up our act in certain key areas. I'm not critical of the initiatives, but in looking them over and in trying to be as practical as I can about what I might do during my tour of duty in the building, I am trying to select maybe 3 or 4 or 5 for special emphasis. I think, based on my experience in the business world, that by trying to do too much at once, for example, by taking all 32 initiatives and trying to apply an equal amount of pressure to each of them, you dilute your effort to the point that you later look back on the track record and you can't see much progress in certain areas which, 2 or 3 years before, were considered to be pretty important.

A Learning Process

You all, and your colleagues in all of the services, are very key to this acquisition process and its improvement. But I think that the program management ranks are still hampered by the military career system of job rotation, and I hope we can improve the career path in that category. There is certainly a learning process you must go through in program management. Even though you may spend 5 months here, those of you who go into a major program office without ever having brushed up against a major weapon system are going to need an on-the-job-

training path. You will be in that learning category for quite a while before you can really be effective.

Lack of Emphasis on Planning

The most interesting part of the life cycle is the development part. I think the services do very well in establishing a requirement, although there are certainly some requirements around now that seemed pretty good a few years ago but that aren't pulling their weight at the moment. But establishing the requirement, establishing a competitive environment, and then taking a system through the test and evaluation and engineering phase is the fun part, and that's where the services generally excel. The problem comes in the production phase of the program, where the big dollars are. I don't think production planning is as well understood in the services, across the board, as it should be. Nor do I think there's enough emphasis on business management, as opposed to the engineering expertise that is required to be a good program manager or have a good program management office.

Responsibility and Authority

In order for program managers to really do their job, I think the program management environment must be changed, and that's not your responsibility. That's more on my level, and my job assignment. I think, for example, that in addition to setting up the right career environment, it's important that responsibility and authority come much closer together in the program management office. By that I mean the further I can press day-to-day programmatic decisions down into the program manager's lap, where the responsibility is, the better I like it. Now, in order to do that we have to reach, very often, all the way across the river over into Congress, and try and get their sticky fingers off the management of particular systems. While they admit individually that they shouldn't be into the micro management of the budget to the extent they are collectively, they don't do much about disengaging themselves. And I don't know how much good I can do in that regard, but I'm certainly prepared to call it to their attention and to do what I can to bring a lot of that back into the Pentagon. This is certainly going to be a rather tough and rather subtle program on my part and on the part of an

Program Manager

awful lot of other people in the Department of Defense. But it's certainly time that we tried.

The DOD-Industry Relationship

Another thing that's always disturbed me, which I would hope to do something about, is the relationship between DOD and industry. This varies a lot, depending on the program, depending on the company, and the program managers involved, but in many cases the DOD and industry personnel that are sharing a common program are in more of an adversarial relationship than they are a team relationship. Now, when you say "team relationship" around this town, you have to be careful, because somebody's going to dredge up the military industrial complex again, and that is not what I mean when I say a team relationship.

I think the system needs more guts than it is willing to display from time to time.

To me, a team relationship means that when you write a contract to enter into a major or even a minor weapon system program that's going to last for several years and take you, in some cases, to the leading edge of technology, you are agreeing to go down the road together. It means that as you get more and more knowledge about this program, you have the ability and the trust in each other so that you can perform trade-offs of performance, schedule, and cost in order to come up with best possible system in the end.

I've seen in the past, and I know you all have too, cases where you set up a requirement, announce that there is a winner, draw up a contract that binds both of you in irons, and then you just go down the road blindly, ignoring some of the developmental facts of life that come to your attention, all because the contract won't let you move. Now, certainly, you can go too far in the other direction. At all times, there has to be an arms-length relationship, because any time a contractor gets the feeling that competition is non-existent, he will not respond the way he would if he were always running a little bit scared that the competition could come in and take away some of

his hard-earned or hard-fought business.

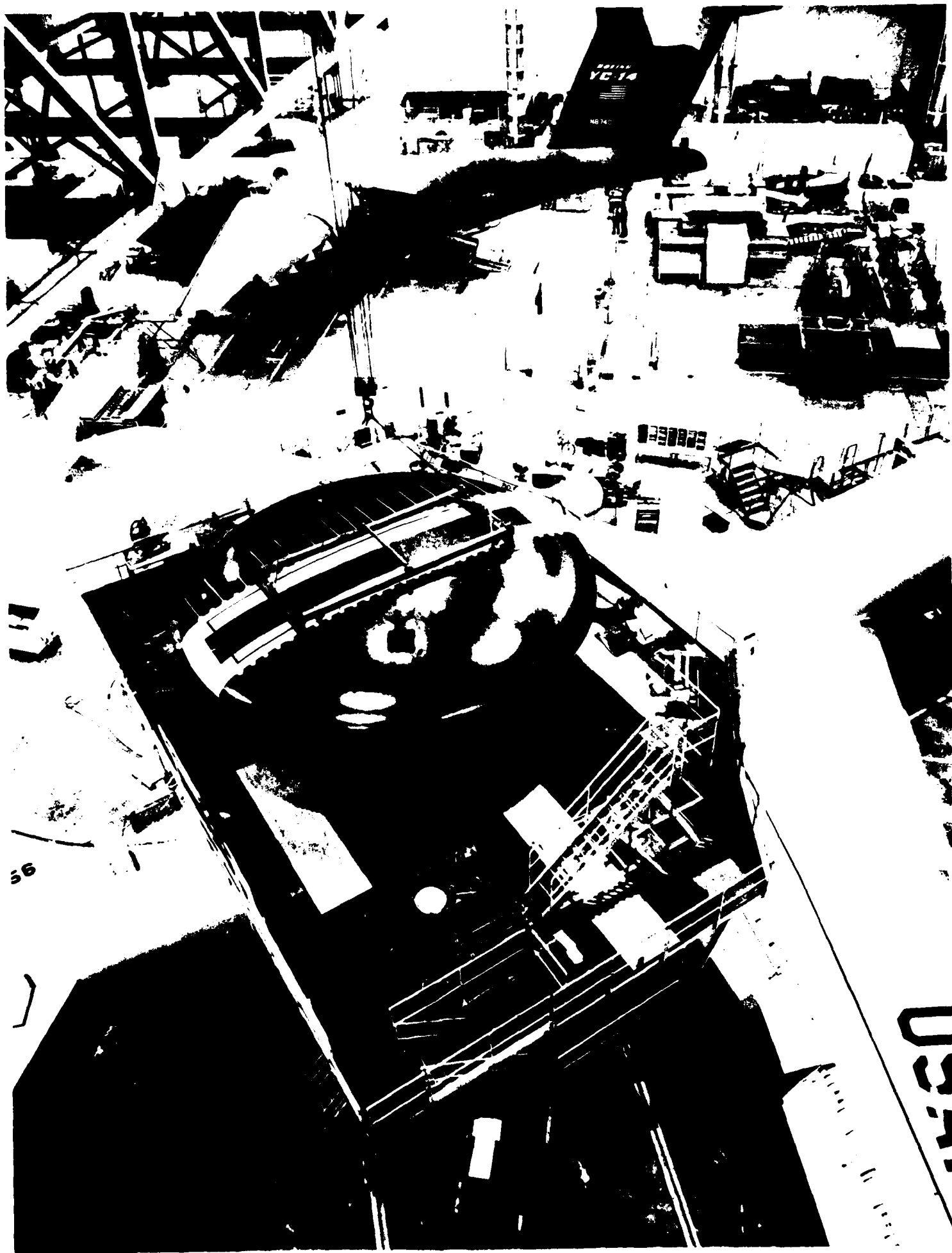
Killing Marginal Programs

I think the system needs more guts than it is willing to display from time to time. By that I mean the guts to step up to a marginal program and cancel it. Everybody makes mistakes, even the Department of Defense. We develop a set of requirements to meet the threat, and then either the technology and the requirement don't mix, or the threat disappears, or it was just a bad scene in the first place, and instead of recognizing that and stepping up and cancelling it, we let it limp along, hoping that somebody on a future watch will come in and do it. But here again, I would hope that one of the things I can help us do is to recognize and admit a marginal program when we see one and get rid of it because, believe me, there are going to be some budget cuts by Congress, and we're going to have to start prioritizing our systems to a much greater degree than we've been willing to do before. We're going to have to face, I think, some hard decisions. Because of this bow wave that is building up in front of us, we are going to have to eliminate some systems rather than continue to stretch out or take money from spare parts and operational funds. We're going to have to face up to the fact that we've got too much on our plate.

Concurrency

Starting way back in the McNamara days, we started getting very cautious about how we managed our programs, particularly those with any degree of technology. We set up a sequence of putting one step in front of the other. Concurrency became a dirty word. We wanted to make almost 100 percent sure that the phase we were in at any one time was complete, that we had it in our hip pocket before we moved on to the next step. Consequently we have brought the time from conception to initial operational capability from a few years to twice that. Some systems have been in development for 7 or 8 years and they still aren't ready. Here again, I know the pluses and minuses of concurrency, but I think it's been proven, at least to my satisfaction, that time is money. If we can take some technical risks when we have a well-run program, accepting the fact that

(Continued on page 23.)



PRODUCTIVITY ENHANCEMENT

A Clear and Present Challenge

David D. Acker

The United States has made great strides in science and engineering through its free-enterprise system. However, the leadership of this country in productivity enhancement is being seriously challenged by the industrialized countries of the Free World. Thirty years ago, 80 percent of all technological innovations were marketed by the United States. Today, the United States is marketing less than 50 percent. What are DOD and the defense contractors doing to enhance productivity during this period of inflation and recession? This paper will present the results of an investigation into this matter.

Productivity enhancement is important to both industry and DOD management. In industry, productivity growth leads to lower costs, and provides an opportunity for lower-priced products and/or higher profits. It also makes possible increased compensatory benefits for employees. In DOD, productivity growth helps to ensure that defense system programs will meet cost and schedule targets, thus providing more resources for other defense needs. Recognizing the importance of productivity enhancement, the Office of the Secretary of Defense (OSD) has established productivity enhancement as one of the goals to be met in the DOD Acquisition Improvement Program, a program launched in the spring of 1981 by Frank C. Carlucci, then Deputy Secretary of Defense.

Definition of Productivity

The productivity of any industrial firm is a measure of how well the resources in that firm are brought to-

gether and used to accomplish a set of results. Productivity isn't just an increase in the volume out the back door, although this is one element. Traditionally, productivity has been defined as the acceptable output per labor hour.¹ Using this definition, we would quickly discover that in a firm with many employees and little automation, productivity depends principally upon human achievement.² On the other hand, in a firm where automation predominates, the human contributions to productivity play a lesser role.

Fred Steingraber has written a fine summary of how the definition of productivity has changed over the years. This is the way he sees it:

... the definition of productivity has changed considerably over the past fifty years. Back in the 40s and 50s the measurement of productivity focused on output, or the production of as much as possible. In the 60s and 70s, quantity was no longer as important as efficiency, or production at the lowest possible cost. Now in the 80s, given the constraints imposed by scarcities, regulations, changes in job skill and cost mix, and greater international competition, the productivity emphasis is on effectiveness. Corporations are increasingly liable for the quality of their products and the services they offer. [Corporations] are considered social entities, not just economic entities. And, as social entities, [they] are held accountable for attitudes toward issues ranging from the environment to

the quality of life in the work place and ultimately to the quality of the product delivered. As a result, the definition of productivity as output over input is useless unless we realize that output now includes in addition to product such factors as quality, service, and safety, while the input is government, unions, people, money, technology, information, motivation. . . .³

Productivity is more than output over input. It is the relationship of the quantity and quality of products, goods, and services produced to the quantity of resources (personnel, capital, facilities, machine tools and equipment, materials, and information) required to produce them. In order to improve productivity in an industrial firm, both the output (performance achieved) and the input (resources consumed) must be capable of measurement. The ratio set forth below provides a measure of how well the expended resources are able to accomplish the established performance objectives, i.e., the ratio provides a measure of the value added.

$$\text{Productivity} = \frac{\text{Performance achieved}}{\text{Resources consumed}}$$

George Kuper of the National Commission on Productivity and Work Quality has defined productivity in a different way.⁴ He describes productivity as a comparison of the magnitude of the results (effectiveness) with the magnitude of the resources used (efficiency). His formula, which appears equally acceptable to the one above, can be expressed in this manner:

$$\text{Productivity} = \frac{\text{Effectiveness}}{\text{Efficiency}}$$

Today, when the defense market is dynamic and changing, the key to productivity growth depends to a greater

The Airborne Warning and Control System (AWACS) 9.1-meter-diameter rotating radome is being installed at a Boeing Company plant. Boeing Aerospace Program Manager

■ Mr. Acker is a Professor of Engineering Management in the Research Directorate at DSMC. ■

extent upon technological innovation and the manufacturing technology employed than upon capital investment or resourceful workers. At this point it is important to understand where the United States ranks in productivity growth among the industrialized nations of the Free World. Unfortunately, the United States is now last in the rankings. This provides us with a measure of the attention that we, as a nation, have been giving to this important subject. Some of the details are discussed below.

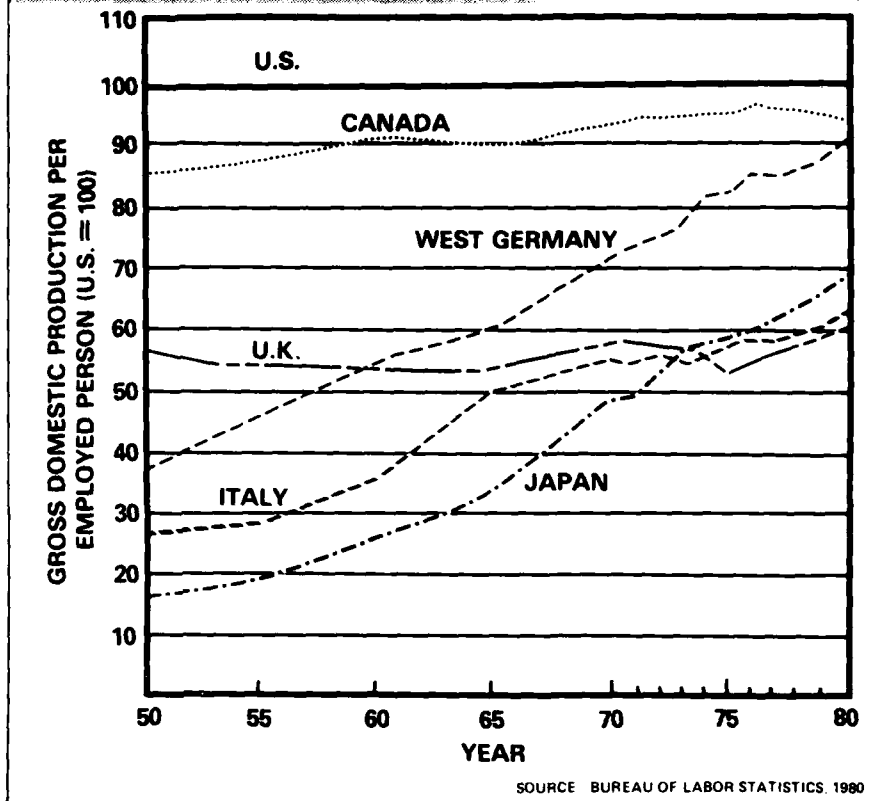
Trends in Productivity Growth

Until the last two decades, most U.S. managers took little interest in either European or Japanese management practices or production systems. This may be attributed principally to the fact that the United States has been the number one industrial nation. In recent years, however, both the United States and Europe have been losing their dominance in many different industries to the Japanese. The results of recent studies of Japanese improvements in productivity, product quality, and management have become the bases for changes in industrial practices worldwide.

During the 1950s and 1960s the United States maintained a relatively high productivity growth rate. During the 1970s the growth rate declined, but the United States is still ahead of the rest of the world. The Bureau of Labor Statistics in the Department of Labor indicates that when comparing the real gross domestic production per employed person—the national measure of productivity—the United Kingdom is 39.5 percent behind the United States, Italy trails by 39.4 percent, Japan by 31.6 percent, West Germany by 11.3 percent, France by 10.6 percent, and Canada and the Netherlands by 8 percent. The challenge to the United States from other countries is a real one. It will take commitment—commitment to more innovation and commitment to strong leadership.⁵ See Figure 1.

The international productivity rating relative to manufacturing of many industrial nations of the Free World is depicted in Figure 2. When reviewing Figure 2, the obvious question one might ask is: Why does the productivity rating of the United States look so bad when compared with other industrialized countries? Part of the answer is that productivity has two

Figure 1. INTERNATIONAL PRODUCTIVITY RATING RELATIVE TO MANUFACTURING: 1950-1980



meanings. One concerns the work force—how hard people are working. The United States looks good on this basis. The other concerns the number of end-products or the dollar value of the end-products people are producing per hour. On this basis, the United States does not look as good. Referring again to the figures of the Bureau of Labor Statistics, one finds that the gain in manufacturing productivity in the United States from 1970 to 1980 is less than increases in Japan and several European countries. See Figure 3.⁶

This trend is disturbing. If it continues, it will undermine: the ability of the United States to compete in the world markets, the U.S. standard of living, and the ability of the DOD to acquire defense systems at affordable prices.

The productivity gains in other countries didn't just happen. The gains came about as a result of the application of computer-integrated manufacturing technology and a well-conceived management philosophy and style. It involved a resolution by managers of industrial firms to:

—Use the work force imaginatively

and flexibly, and recognize that the people in the work force know how to increase productivity.

—Make workers feel they are part of the "team."

—Make workers a part of the communication channel and listen to what they have to say.

—Recognize the dignity of each worker, and the worker's right to privacy.

And there is a bright side of this story. Thomas J. Peters of McKinsey and Company and Stanford University found in a recent study that the best run and most successful U.S. industrial firms are outperforming typical Japanese firms in the three areas where their managers also excel. These areas are:

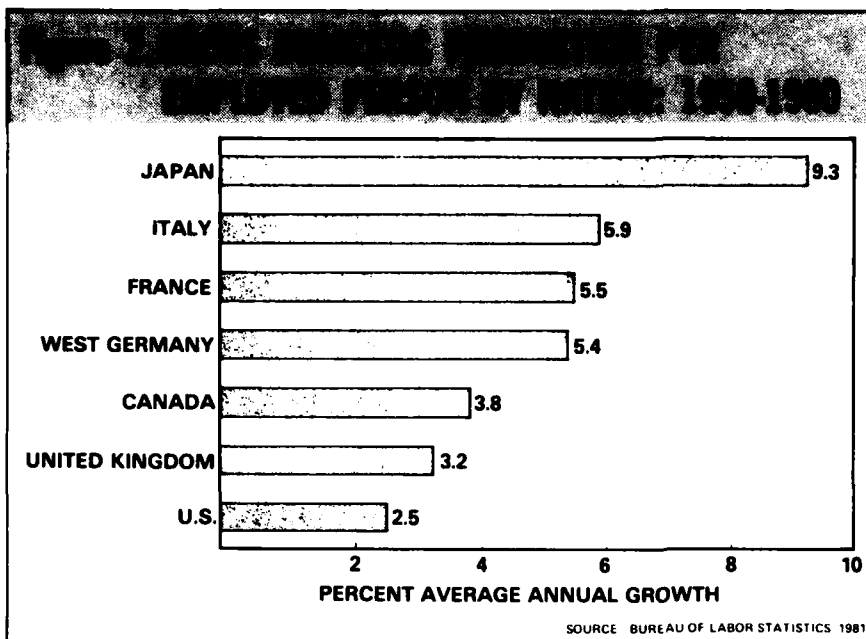
—Handling members of the work force with individualized concern and thoughtfulness.

—Focusing on the quality of the product.

—Paying extraordinary attention to those needs of the user.

Factors That Influence Productivity

Although it is clear that productivity in the United States has stagnated, the



factors that influence productivity growth are known; however, because of their complex interrelationships, it is difficult (if not impossible) to determine the specific effect of each one. The rest of this article will focus on the key factors: the work force, capital investment, and technology. Now, let's consider each of these factors.

People Factor

The members of the work force represent an integral part of the productivity growth picture. This is portrayed in Figure 4. Referring to this figure, you can see that each of the three categories—people (work force), process, and product—is composed of subordinate elements, any one of which can impact productivity growth. Productivity growth occurs when the cumulative effect of the interdependent elements is imposed.

QUALITY OF THE WORK FORCE

The quality of the work force effects productivity. As the quality increases or decreases, the productivity increases or decreases. There has been a decline in the quality of the work force in the United States during the past few years. This decline can be attributed to a rise in the proportion of young and inexperienced workers in the work force and the decrease in the average work effort. Also, the lack of motivation of many young workers has had an adverse affect on productivity.

One of the actions that needs to be taken to increase productivity in our industrial firms is to increase the an-

nual supply of engineering graduates. A critical problem in our high-technology industries is that of sustaining the growth potential inherent in the industry with so few new engineering and scientific graduates. During the past decade, the number of engineers working in industry rose 62 percent in Japan and 59 percent in West Germany; however, the number of engineers in the United States dropped 13 percent. According to the American Electronics Association (AEA), in 1981 there were about 13,000 new engineering graduates to fill the 29,000 openings for electrical engineers and computer software engineers. In 1985 there will be only 15,000 engineering grad-

uates to fill the 51,000 openings that will be available at that time. One of the contributors to this problem is the shortage of engineering faculty members. In 1980, for example, 15 percent of the engineering faculty positions were unfilled.

Then, there is a problem of turnover. The engineers who have prime responsibility for technological innovation turn over about every 10 years. Typically, following graduation, engineers focus on developing and ap-

Figure 4. PRODUCTIVITY RESULTS FROM EFFECTIVE INTERACTION OF THE PEOPLE, THE PROCESSES, AND THE PRODUCT

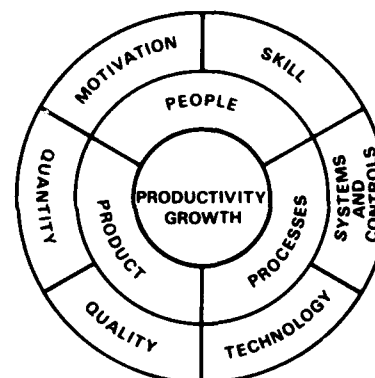
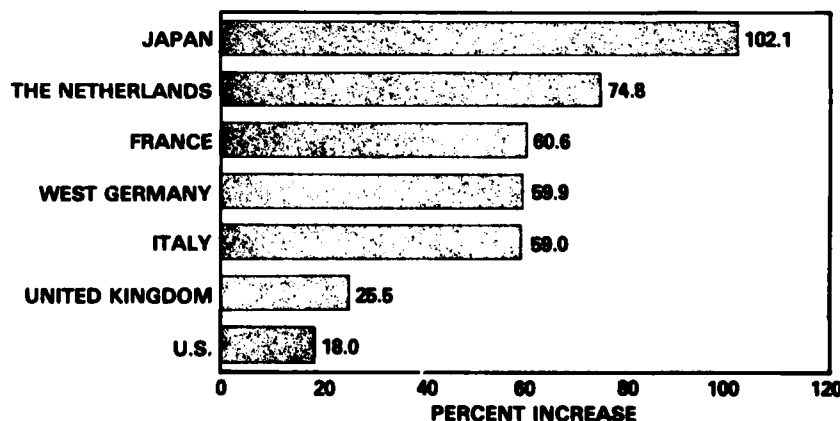


Figure 3. MANUFACTURING PRODUCTIVITY INCREASES: 1970-1980



plying new technology. Then, after 10 years, they join the ranks of management. This means that educators influence 10 percent of the engineering work force annually through the new graduates to whom the technology has been transmitted. It is incumbent, then, on the members of engineering faculties to keep abreast of the state-of-the-art in their specialty areas so the latest knowledge can be imparted to the students.

QUALITY OF MANAGEMENT

One of the keys to productivity enhancement within any organization is management. The attitudes, actions, and personal examples of management pervade the organization and affect directly the attitudes, actions, and motivation of the work force. It is from management that the workers generally take their cues. Accordingly, astute managers must convey clearly the importance they place on productivity, and their desire to enhance productivity throughout the organization. Unfortunately, actions that management takes to improve productivity in one organization may not work out well when applied to another. Therefore, it is important for managers to assess the situation within their organization before taking specific actions to enhance productivity.

A manager concerned with improving productivity might begin by conducting a critical self-examination and then taking action to overcome the deficiencies found. Chart 1 provides a basis for such an examination. Any question that does not generate a strong "yes" response identifies an area where the manager must try to change his (her) performance.

COOPERATION BETWEEN MANAGEMENT AND THE WORK FORCE

Cooperation is another key to productivity; and the quality of work in industry. The question is how does one obtain cooperation between management and the work force?

There are several steps that management can take, namely:

- Open a line of communication by holding weekly "rap" sessions.
- Organize groups with employees from various functional organizations. "Quality circles" and "productivity circles" are examples of such groups. The title is unimportant.
- When the line of communication is open, listen with an open mind.

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AMP Incorporated

Managers must convey clearly the importance of productivity and their desire to enhance the productivity of the organization.

- Investigate the merits of suggestions made by the "circles."
- Implement changes based on the merits of suggestions received.
- Announce the actions taken by management.

When management takes the steps listed above, the workers will recognize that their cooperation is important.

PITFALLS

There are several pitfalls of a general nature that a manager in industry or government may encounter when trying to enhance productivity, namely:

- The plan for improving productivity may not be implemented properly.
- Improvement in productivity in one organizational unit might take place at the expense of another unit.
- If improvement in productivity is not sufficient, employees might drift back to "the same old way" of doing things.

An example of computer-aided engineering installations being used by industry in the development of new products.

—The pace in seeking productivity improvements must be maintained. If management enthusiasm is too much or too little, efforts to improve productivity might fail.

—Some short-term improvements might turn out to be counter-productive during a longer period of time.

One of the most common frustrations for management in attempting to increase productivity occurs when there is a short burst of worker enthusiasm with a corresponding improvement in productivity, only to be followed by a sudden decline in enthusiasm. The chief reason for such failures might be manager tunnel-vision—the failure of the manager to recognize that there are many interrelationships that have to be developed.

There are several approaches to productivity enhancement where manager tunnel-vision can occur. For example:

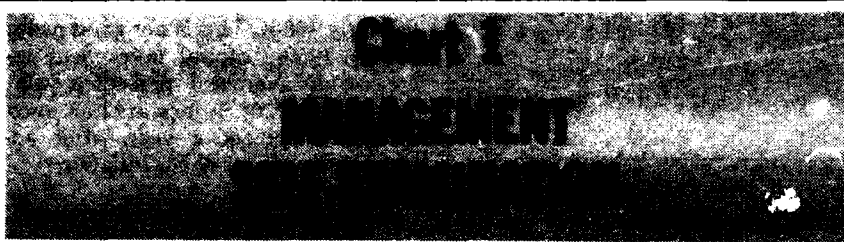
—Productivity problems are limited to manufacturing. Problems appear in manufacturing, but they are seldom the only causes of declining productivity.

—Work incentives. Direct labor is productive; however, production workers sometimes "go into business for themselves" when they are placed on an incentive plan. They play games—games that will increase their own income—often at the expense of productivity. For example, they hoard tools, materials, and/or knowledge.

—Special campaigns. Managers sometimes believe that special campaigns or pep talks will increase worker motivation and, thereby, improve productivity. Too often managers concentrate on the symptoms of a problem and not on its causes. When the campaigns are over, the workers sometimes return to their old habits.

—Cost reduction across-the-board. Cost reduction plans have to be tuned finely. When costs are cut across-the-board, say 8 to 10 percent, they might only touch the surface of inefficiency in one department and seriously weaken the ability of another department to accomplish its role. Caution has to be exercised in any cost-reduction program.

March-April 1983



- Do I try to discover employee needs and respond to them?**
- Do I discuss job performance with each employee periodically, and encourage him/her to improve performance, thereby enhancing productivity?**
- Do I try to maintain or improve the productivity of my employees—who may have different values, attitudes, and motivations than I have—through training and education?**
- Do I recognize and reward subordinates who continue to complete their assignments in a satisfactory manner?**
- Do I ever remove incentives from employees who appear to be performing below a "standard," forgetting they may be already performing to the best of their abilities and cannot do better?**
- Do I hold forums on a planned basis to exchange ideas, to identify problems or potential problems within the organization, and to promote cohesiveness within the organization?**
- Do I encourage healthy competition between organizational units as a method for stimulating improvement in productivity?**
- Do I conduct confrontation meetings in which representatives from each organizational unit involved in a specific disagreement meet to iron out differences?**
- Do I delegate some of my management functions to subordinates who, by experience, training/education, and interest, have shown evidence of being ready and able to assume more responsible work?**
- Do I set a good personal example for employees, and meet their expectations?**
- Do I manage time effectively? Have I established priorities, developed plans, and scheduled the workload to ensure the best investment of the time available to accomplish the tasks to be done?**
- Do I provide suitable physical working conditions for my employees?**
- Do I inspire employees to search for more productive and less costly ways to do things?**
- Do I apply such techniques as work simplification and standardization?**
- Do I encourage technological innovation and use of the advanced products of technology?**
- Do I eliminate functions found to be redundant or unnecessary?**
- Do I minimize disruptions to the work being performed?**
- Do I minimize the amount of paperwork required to accomplish each assignment?**
- Do I encourage effective communication within the organization and use the proper channels of communication myself?**
- Do I provide for feedback on work in progress?**

—Self-improvement. When higher-level management permits functional departments to set their own goals and to meet them in the way they deem to be most appropriate, the opportunity to coordinate activities between departments is diminished. If a department overacts, that department might actually reduce productivity creating a conflict with another department—a conflict that did not exist previously.

—Competition. Managers sometimes think that competition between workers (or departments) will benefit the organization. Unfortunately, the opposite might occur. The cooperative attitude that existed between workers (or departments) might become damaged during the competition. If so, a counter-productive environment will emerge.

—Crackdown on absenteeism and tardiness. Some managers are prone to think that the cause of absenteeism and tardiness originates in the work force, and that disciplinary action will solve the problem. This might not be so. The problem might be caused by poor working conditions, poor organization of the work to be accomplished, or weak management. Absenteeism and tardiness can be reduced by correcting conditions that brought them about in the first place.

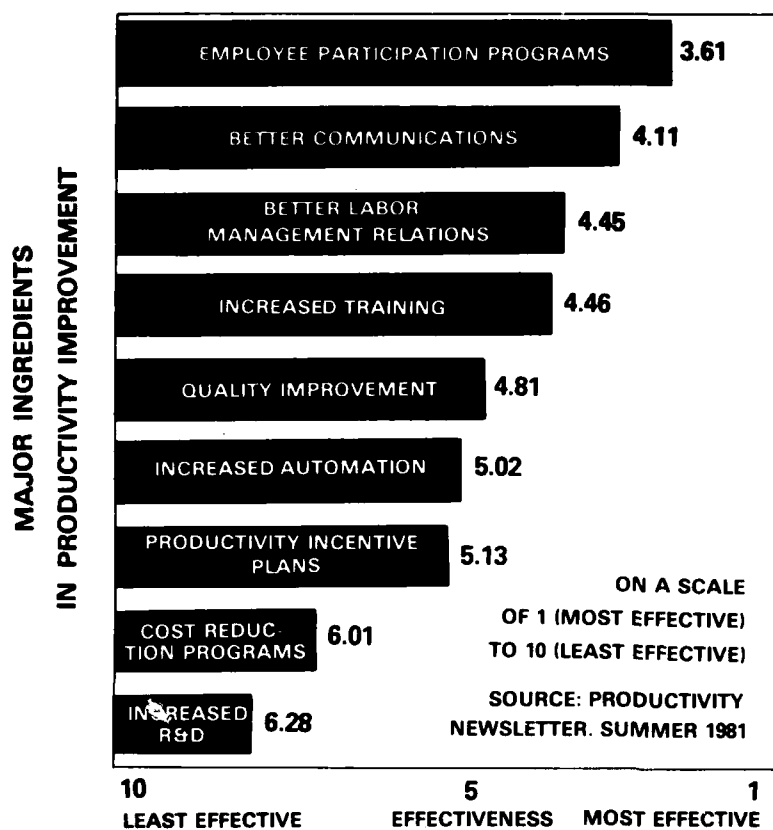
—New hires. When seeking the best-qualified person to fill a vacancy, managers should avoid hiring a better-educated person than the position requires. Organizations cannot afford to have under-utilized talent on hand for extended periods because motivation will become a problem and productivity will fall off.⁷

Each one of the management approaches cited above can be taken with the objective of enhancing productivity. However, as indicated, the approach taken might create a new problem, even if it successfully solves a problem at hand. Management should recognize that many productivity problems can be solved only by an attack on several fronts at once.

A recent issue of the newsletter *Productivity* indicated that people—the work force—are the most essential ingredient in any productivity improvement program.⁸ The publisher of the newsletter, Norman Bodek, reporting on the results of his survey, stated that the most effective way to bolster productivity is through employee participation programs (Figure 5). Better communications ranks second, followed by improved labor-management

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MAJOR INGREDIENTS IN EFFECTIVENESS IN IMPROVING PRODUCTIVITY



relations, increased training, improved quality, increased automation, and others. More than half of the companies surveyed have some kind of employee-participation program.

Now, let's turn to the factors that affect investment in technology.

Factors Affecting Investment in Technology

THE SITUATION AT THE START OF THE 1980s

Capital investment is absolutely necessary if productivity is to be enhanced. At the start of the 1980s the picture is grim. The cumulative U.S. capital investment requirement for the 1980s is about \$5 trillion. This figure exceeds the sum total of all capital investments made between 1900 and 1980. It will average \$350 billion more per year than was spent in the last 20 years.⁹

According to some surveys capital investment—after adjustment for inflation—may not show much growth in the early 1980s. This is not good news. In the 1960s, capital investment increased an average 6 percent a year, and in the 1970s, it increased an average of 4 percent a year, after adjustments were made for inflation.

REASONS FOR DECLINING INVESTMENT
Inflation: During the 1970s, the average annual inflation rate was 7 percent. In the 1980s, the average inflation rate may be 9 or 10 percent. This increase over the 1970s will add about \$650 billion to the capital required by the private sector. Just at the time we need more capital than ever before in our history, industry is facing lower earnings, high interest rates, less equity financing, eroding profits, and lower bond ratings. The portion of U.S. capital stock (technology equipment—and facilities) that is 5 years old or less has been declining steadily since 1969, and the share of our total investment identified for building technological capital has been declining at an alarming rate.

Inflation affects productivity negatively. Look at what has been happening. The prime rate changed twice between 1934 and 1948. It changed 16

General Motors engineers developed the concept of the Programmable Universal Machine for Assembly (PUMA) to handle small, lightweight automotive components. The PUMA robot is shown here in a laboratory demonstration.



General Motors

times in the 1950s and again in the 1960s. In the 1970s it changed 130 times, and in 1980, 39 times. It might change more than 200 times in the 1980s. It is very difficult for any business, including defense, to plan adequately with changes of this nature. What does this do to productivity?

Productivity is influenced by the dollars industrial firms are able to set aside for investment in new technology, equipment, and plants. The Japanese set aside about one-third of their economy annually for investment in new technology, equipment and plants over the 15-year period ending in 1979. During that period, the productivity in Japan grew about 8 percent a year. For the 15 years ending in 1979 the West Germans set aside about 25 percent of their economy annually for the same purpose and their productivity grew about 5 percent. From 1962 to 1979, our country set aside between 10 and 12 percent of its economy for capital spending. Our annual rate of productivity growth was about 2.5 percent annually from 1962 to 1977, and there was no increase at all in 1979. In 1979, it was minus 2 percent. It seems apparent, then, if the United States is looking for a way to improve productivity, it needs to stimulate capital spending.¹⁰

Short-Term Outlook. Tom Wolfe, contemporary author and social critic, believes that the greatest source of productivity loss in the United States in the 1970s was in the short-term orientation of industrial managers. Managers who occupy their positions for short periods of time, either because of job rotation or turnover, are not prone to make long-term investment decisions—substantial capital investments. Further, industrial firms have problems in executing long-range and consistent company strategies when management changes frequently. Finally, there seems to be a trend among chief executive officers and defense industry away from engineering backgrounds toward financial backgrounds. Perhaps some of our problems today are the result of the muted voices of engineering and manufacturing executives when key policy decisions are made.

Wolfe bemoans the rise of self-centeredness in our social fabric. Unfortunately, the lack of commitment he has observed in our social fabric has also begun to appear in our industrial fabric. The stockholders in our industrial firms are demanding higher short-term

Program Manager

earnings. But industrial growth calls for capital investment and this reduces short-term profits. How, then, can we convince the management of industrial firms in the United States to make long-term commitments to research and development, automating the factory, and corporate growth, if promotion policies and compensation systems continue to provide them with rewards for their short-term accomplishments?

United States industry must continue to stimulate research and development (R&D) and encourage innovation. Richard L. Terrell, Vice Chairman of the Board, General Motors Corporation, has pointed out that industrial firms should "... break new ground.

U.S. industry must stimulate R&D and encourage innovation.

There is always some risk in doing the untested, but there are also great gains to be realized when we experiment and when we succeed." Mr. Terrell's challenge is well founded. If U.S. industry had accepted this challenge sooner, the percentage of the gross national product (GNP) may not have dropped so precipitously between 1960 and 1980 (Figure 6).

SYMPTOMS OF THE PROBLEM

For the past several years there has been a serious deterioration of the U.S. defense industrial base.¹¹ Along with this deterioration, productivity has fallen off. Martin Baily believes that a reasonable case can be made that the slowdown in productivity can be associated with the decline in capital investment and the quality of the work force. He says that "... some capital goods have become obsolete and capital spending has been used for purposes other than raising productivity. ... Much of the capital stock (technology, equipment, and facilities) is obsolete."¹² On the other hand, much of the recent decline in productivity can be attributed to slack in our factories.

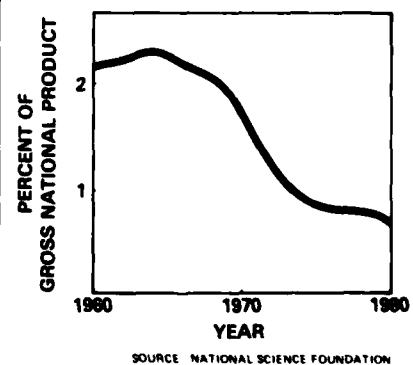
A special panel of the House Armed Services Committee, which studied the status of our defense industrial base in some detail, reported the following findings at the end of 1980:

- A continuing deterioration and contraction of the defense industrial base.
 - Lack of a plan for defense industrial base preparedness.
 - Turbulence in defense system (weapons) programs.
 - A shortage of critical materials and a growing dependence on uncertain foreign sources for these materials.
 - Restrictive procurement policies and procedures.
 - Tax and profit policies that discourage capital investment.
 - Diffused responsibility for the condition of the industrial base.¹³
- If the deterioration of the defense industrial base continues, the United States will not be able to regain the rate of productivity growth it once enjoyed, and the cost of defense systems will continue to rise.

SOLUTIONS TO THE PROBLEM

Centers for Industrial Technology. Public Law 96-480 addressed the problem of outdated plants and equipment by encouraging U.S. industrial firms to renovate or replace those that are outdated with technologically superior plants and equipment. This law provided \$285 million over 5 years to create centers for industrial technology at universities and nonprofit institutions. It had been hoped that this would encourage the coordination of the research resources of the universities, the private sector, and the government. Unfortunately, the provisions of the law have not been fully funded.

Figure 6. INDUSTRIAL SPENDING IN U.S. FOR RESEARCH AND DEVELOPMENT



Taxes and Depreciation. The tax policy changes contained in the Economic Recovery Act of 1981 have not revived the economy. Some economists think it will take 2-3 years before the impact of the changes will be felt.

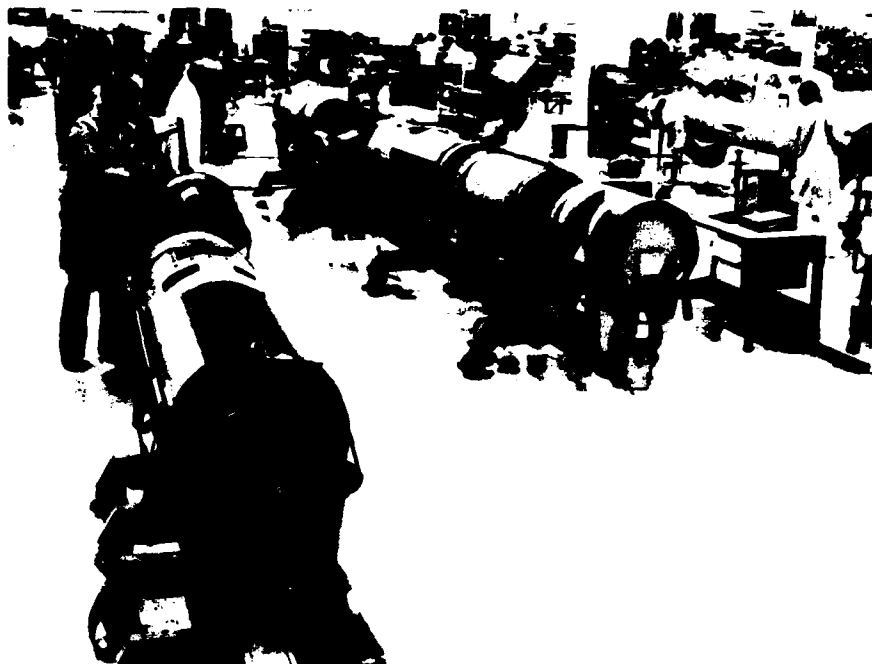
One of the reasons that defense contractors have been reluctant to make any capital investments at this time is because of the restrictions contained in Cost Accounting Standard (CAS) 409, "Depreciation of Tangible Assets." This standard prohibits rapid depreciation of capital equipment and fails to recognize replacement depreciation costs. The CAS 409 cannot be changed without the approval of a CAS Board. Such a board no longer exists. The Joint Logistics Commanders, recognizing the need for a change to CAS 409, sent a letter to the Deputy Secretary of Defense (DEPSECDEF) on October 9, 1981, urging that some action be taken. In response, the Deputy Under Secretary of Defense, Research and Engineering (Acquisition Management), is supporting the establishment of a CAS function within the Office of Management and Budget. If such a function is organized, a board could then be formed to take the necessary corrective action on CAS 409, or any other Cost Accounting Standard requiring a change.

Contract Financing and Profit Policy. The Deputy Secretary of Defense has requested that (1) contracts be structured to permit defense contractors to share in cost reductions that result from productivity enhancement, and (2) profit levels commensurate with risk and contractor investment be negotiated.

In support of this request, a DOD Task Force for Improving Industrial Responsiveness has prepared a draft guide, "Improving Productivity," which provides instructions for contracting officers. The instructions explain how to tailor the current contract-inventive clauses—within the authority provided in the appropriate section of the defense acquisition regulation (DAR)—to motivate contractors to make capital investments that will enhance productivity.

The DUSDRE(AM) in a June 1981 memorandum requested that the services and the Defense Logistics Agency (DLA) instruct field elements to select the contract type most appropriate to the risks involved. Implementation of this action should help to ensure adequate profit motivation for defense

Program Manager



General Dynamics

Defense contractors have been reluctant to make capital investment because of restrictions contained in CAS 409.

contractors and encourage productivity improvement.

Relative to profits, the DEPSECDEF has requested that the services grant equitable economic price adjustment (EPA) clauses in appropriate procurements. To carry out this request, the DAR Council is considering revisions to the current EPA coverage that will recognize the impact of inflation on profits. The revision under consideration should provide greater assurance to both contractors and subcontractors that they will not be penalized by unpredictable cost fluctuations.

The DOD Authorization Act of 1982, signed December 1, 1981, repealed the profit limitations on aircraft and ship procurements contained in the Vinson-Trammell Act of 1934. The new act authorizes the President, upon declaration of war or national emergency, to prescribe regulations that he may deem necessary to control exces-

Modern industrial technology is exemplified by the Tomahawk cruise missile, shown here undergoing assembly at General Dynamics Corporation.

sive profits on defense contracts. A revision to the DAR issued in 1982 reflects the elimination of the excess-profit provisions.

We have considered the factors that affect investment in technology. Now, let's consider what technology can do to spur productivity growth.

What Technology Can Do for Productivity

NEED FOR APPLICATION OF TECHNOLOGY

"Economic growth, technological innovation . . . these are the components of progress. These are the engines that drive our country forward," says Herbert E. Meyer, an editor of *Fortune*.¹⁴ The enhancement of productivity is not only affected by the results of research and development, but by application and acceptance of new technology. According to Frank Batten, president of the New York Stock Exchange, ". . . productivity growth [results from] the application of new technology to the production of goods and services." Mr. Batten believes that more than half of the net productivity growth from 1948 to 1977 can be attributed to technological advances.¹⁵ This is somewhat higher than Bodek found in his survey.

AUTOMATED FACTORY

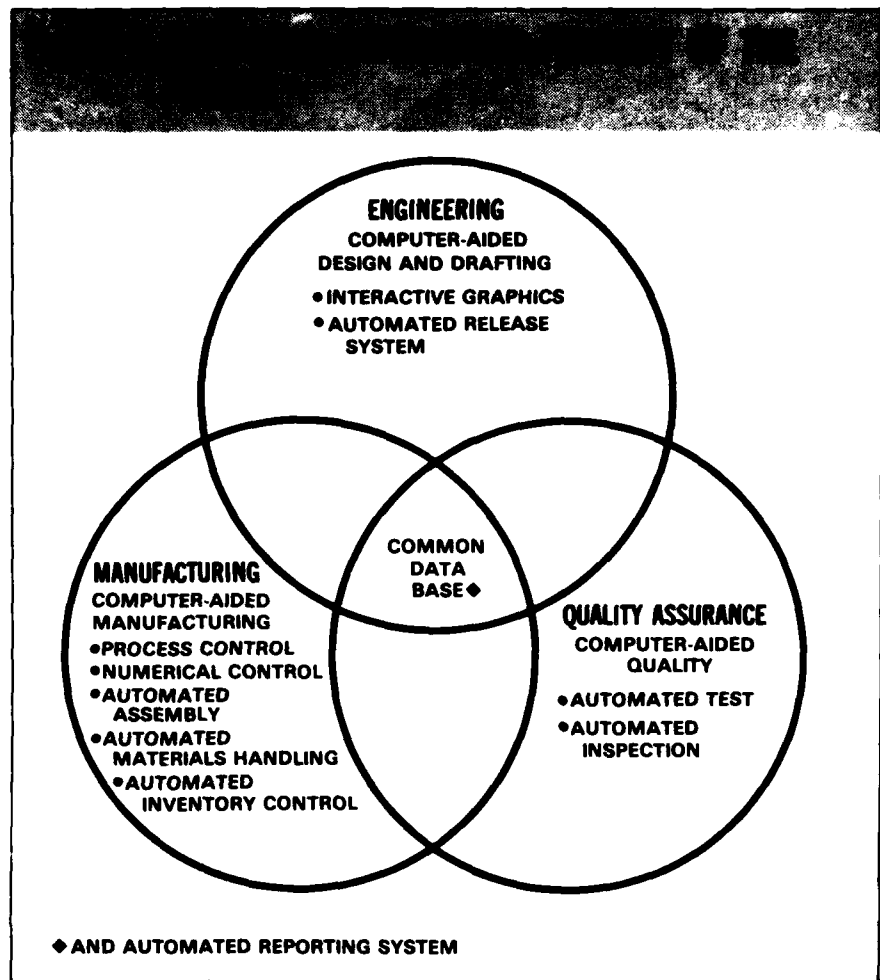
There are far-reaching implications associated with the introduction of the automated factory into the U.S. industrial environment. The advent of factory automation is an exciting and challenging field—one which government and industry believe will reduce operating costs and increase productivity. However, the approach that management takes to introduce automation may be of equal importance to the new field itself.

A well-managed industrial firm is one in which there is an effective integration of the work force and advanced technology. The genesis of such an organization is an implementation plan that includes education of the work force for factory automation, early identification of new manufacturing processes that will lend themselves to automation, manpower/workload forecasting that takes into account factory automation, and a mechanism for worker feedback. The concept of a computer-integrated factory of the future is shown in Figure 7.

A comprehensive strategy is necessary to improve the quality and reliability of products manufactured. With insufficient or poor planning, an atmosphere could be created within an industrial firm in which the work force is educated, and a well-conceived plan for factory automation is implemented, the transition to the automated factory will proceed smoothly, and productivity enhancement will follow.

A robot is a programmable, multi-function manipulator designed to move material parts, components and end-items, tools, and specialized devices through variable programmed motions for the performance of a variety of tasks. When George Devol patented the first robot 35 years ago, he saw a bright future for this technology. He recognized, even then, that robots could provide one of the least expensive approaches to productivity enhancement. Today robots are being used for the following tasks: machine loading/unloading, spraying, palletizing/depalletizing, grinding/deburring/polishing, tool carrying, forging, welding, and assembling.

It is imperative that U.S. industry and the government foster more widespread use of industrial robots. The application of robots was one of the keys to the remarkably high levels of productivity achieved by the Japanese in



A well-managed industrial firm is one that effectively integrates the work force and advanced technology.

the 1970s. If the United States does not make a stronger commitment to robotics and other innovative technologies in the near future, its economy will continue to decline and our industries will lose more ground to competition from abroad. The accelerated depreciation provided in the recent changes to the tax law, along with additional tax credits for installation of innovative technologies such as robots, should give rise to increased productivity in the United States.

The Robot Institute of America (RIA) suggests that U.S. industry assign high priority to the installation of robots, especially in dangerous, dirty, and dull jobs, "recognizing that robots are one of the quickest and cheapest ways to increase productivity." Also, industry must accept the responsibility for retraining workers who are displaced by robots. Industry management will have to communicate with the work force and help the workers to understand the advantages of using robots. Further, industrial managers will have to develop plans so workers will share in the benefits of increased productivity.

Currently, there are about 5,000 robots in use in the United States, as opposed to the more than 60,000 in use in Japan. But the U.S. robotic boom is just beginning (see Figure 8). In 1980, robot sales in the United States totaled \$90 million—\$40 million more than 1979 sales. The 1979/1980 sales represent a quantum jump from the \$1.5 million in 1969 sales. Recently, knowledgeable observers of the robotics



Innovation in manufacturing techniques is a key to increasing overall industrial productivity. Here, numerically controlled painters work at a GM Assembly Division in Georgia.

market have been predicting that U.S. robot sales will reach \$500 million annually by 1985, and \$2 billion by 1990.

ADVANCED COMPUTERIZED MANUFACTURING

Someone has said that "if robots are becoming the tireless arms and eyes of production, then computers are their minds." The versatility of the computer has made it one of the principal elements leading to the automation of the factory. According to the Center for Productivity of the National Science Foundation, computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided test (CAT) have more potential to radically increase productivity than any development since electricity.

The question is: What role will an advanced computerized manufacturing system play in the currently emerging Third Industrial Revolution? Advanced computerized manufacturing systems will assist people in all of the processes necessary to translate the specific requirements of a product into its final physical configuration. These systems will play a major role in such areas as design, analysis, detailing, documentation, numerical control (N/C) programming, tooling, fabrication, assembly, quality assurance, and testing. The application of CAD/CAM at Westinghouse, for example, has resulted in a 25 percent reduction in manufacturing lead time, and as much as a 400 percent increase in productivity.

Advanced computerized manufacturing systems originated at the Massachusetts Institute of Technology (MIT) with the development of numerical-controlled machine (N/C) tools. Then, in the 1960s, automatic programming

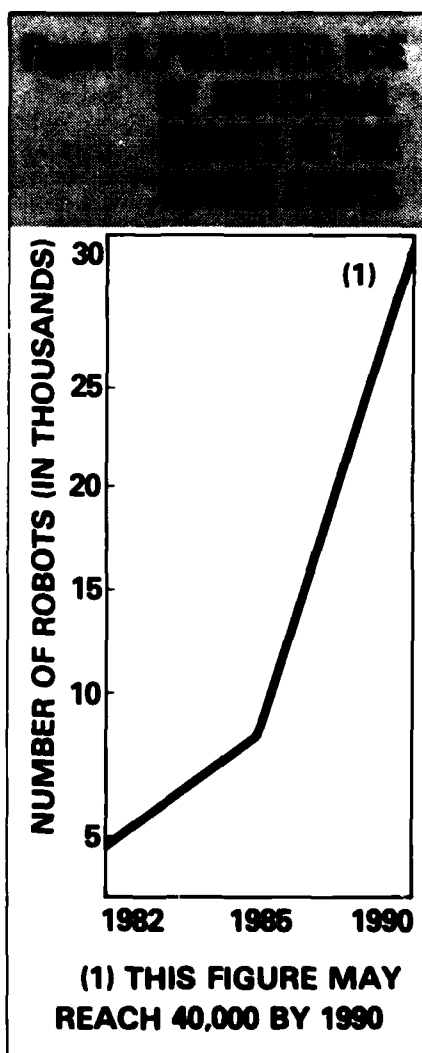
for tools (APT) was developed as the language for N/C programming. This effort was followed in 1963 by Ivan Sutherland's MIT doctoral thesis, "Sketchpad," which provided one of the first basic implementations of an interactive computer graphics system for computer-aided drafting. The General Motors DAC-1 (Design Augmented by Computer) and the Lockheed CADAM (Computer-Graphics Augmented Design and Manufacturing) in the mid-1960s followed.

Today, with the availability of low-cost minicomputers, a design engineer can sit in front of a large CRT screen and graphically construct the three-dimensional geometric model of a part. When he is finished, a manufacturing engineer can use the part's geometric data base. Through interaction with a graphics CRT, N/C machining tapes can be derived and toolpaths verified. Process plans can be created and bills of material can be generated for the manufacturing process.

The declining cost of computer power—about 50 percent every 30 months—will enable defense contractors to increase their use and thus greatly increase productivity. Through the use of these advanced systems, the productivity of design engineers, draftsmen, and manufacturing engineers has increased by a factor of from 2 to 1 to more than 20 to 1 in situations where there is a large amount of repetition or engineering change activity. The General Electric Company, for example, has indicated that the time for tool design has been reduced 25 percent by installation of a Computervision CAD/CAM system. In high-technology industries, such as computers, electronic instruments, and

telecommunications, productivity is now increasing at an annual rate of over 4 percent. This compares favorably with 2 percent or below for other industrial sectors.

The new flexible manufacturing systems in which several numerically controlled production machines are grouped, along with a transport system, under a control of a main computer, are impacting productivity substantially. Using this type of manufacturing system, machine-tool utilization has increased as much as 45 percent in some companies.



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MANUFACTURING TECHNOLOGY PROGRAM

The DOD Manufacturing Technology Program (MANTECH) was initiated a few years ago to improve the productivity and responsiveness of the defense industrial base. In this program, the government shares with industry the risks and costs of establishing and applying new and/or improved manufacturing technologies. Today, the MANTECH program is one of the largest single sources of industrial productivity enhancement information in the United States.

TECHNOLOGY MODERNIZATION PROGRAM

Capital investment and manufacturing technology innovations are key factors in productivity enhancement. The program for determining the advanced manufacturing technology needed, and the capital investment required to apply advanced technology, is referred to as the Technology Modernization (TECHMOD) Program. This program, initiated by the Air Force, involves the coupling of need and advanced manufacturing technology by providing defense contractors, as well as subcontractors, with incentives for capitalization.

The increased use of new technologies such as industrial robots, CAD/CAM/CAT, and new flexible manufacturing systems, will enhance productivity. At the same time, it will challenge both industrial managers and leaders of our educational institutions to meet the need to train (or retrain) the work force on a scale never before attempted. About 45 million jobs will be affected by the automation of U.S. factories and offices. Fortunately, the changeover will take many years. The management of our firms can ease the shock of transition by giving the work force ample notice of impending changes, bringing the work force in on decisions involving automation, and explaining to the work force the advantage of the changeovers. The leaders of our educational institutions will have to find ways to satisfy the need to train new members of the industrial work force and to retrain the old members so all can be qualified to assume new assignments.

Productivity enhancement is especially important in the defense systems acquisition business. It is only through enhanced productivity that we can continue to afford defense (weapon) systems in sufficient quantities to deter or counter any foreign threat to our way of life. In the United States we

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have reached the point at which it has become difficult to sustain the rate of productivity growth we attained in the past. Continuing technological innovation and increased capital investment will help, but they cannot enhance productivity without a work force in tune with the need. The ability, attitude, and action of the people in the work force will have a pronounced effect on the future growth of productivity in this country.

Tomorrow we will grade our managers on how well they were able to use the advanced technology, capital, and human resources they were given today to enhance productivity. We will hold our managers less accountable for short-term performance than long-term performance and their contributions to productivity enhancement. Peter F. Drucker, noted authority on management, summed it up very well when he said, "Productivity is the first test of managements' competence."

SERVICE TECHNOLOGY PROGRAMS

As part of the DOD Acquisition Improvement Program initiated on April 30, 1981, the military services have accomplished the following relative to increasing productivity in contracts for defense systems:

—The Army implemented an Industrial Productivity Improvement (IPI) Program after receiving approval of its plans from the Secretary of the Army. An IPI Program is being used at the Rockwell Hellfire missile plant, the Martin Marietta Pershing II missile plant, the General Dynamics M-1 tank plant, and others. The Army is requesting a low of \$86.9 million in FY 83 and a high of \$269.9 million in FY 87 for the IPI program.

—The Navy has invested \$77 million in MANTECH during the past 5 years. It has budgeted \$8 million per year in the out-years. During the next 5 years the Navy's MANTECH Program will emphasize four areas, namely: aircraft and air combat systems, shipbuilding technology, ship combat systems, and electronics.

—The Air Force has a TECHMOD Program. When applied to the F-15 aircraft program, TECHMOD provided the first successful demonstration that government costs could be reduced during acquisition. The initial success of the F-16 TECHMOD program prompted the Air Force to consider application of the concept to other systems that will have long production runs.

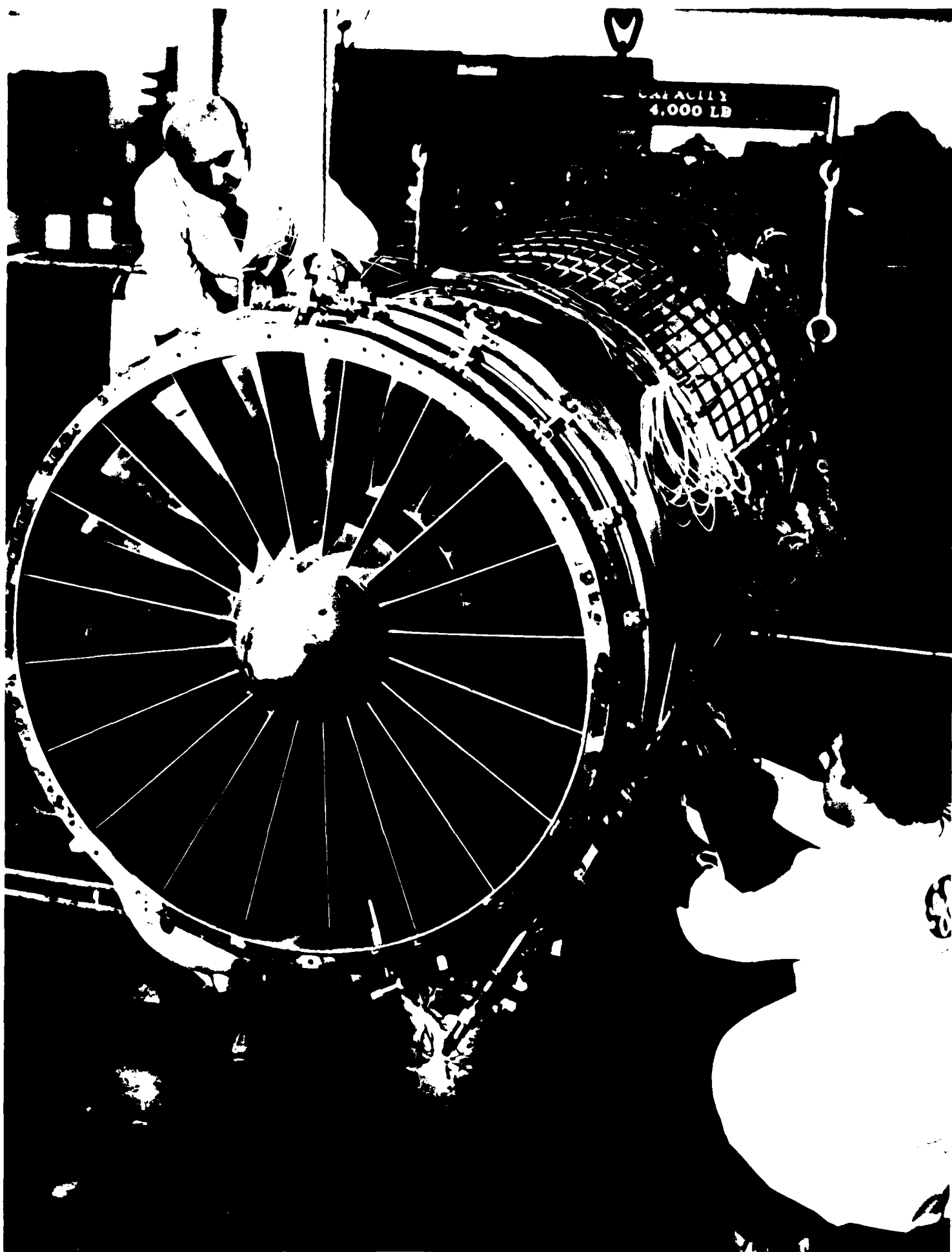
The new MANTECH Program Initiative is under way. It will provide productivity and production efficiency improvements for the B-1B industrial base. Initial assessments indicate that a 5-to-1 payoff is possible.¹⁶

Summary and Final Thoughts

The rate of productivity growth in the United States has been declining for many years. This decline cannot be attributed to a single cause, and a single action will not readily change the way it has been going. It will take a combination of actions. ■

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The PM's Role in SURGE AND MOBILIZATION CAPABILITY

Colonel Jerry C. Harrison, USA

There is a justified and growing concern both in government and industry that if the nation were required to surge or mobilize its industrial capacity, serious deficiencies would exist. These deficiencies would result in reduced sustainability and would, in the final judgment, limit our ability to achieve a favorable outcome in a conflict or crisis.

To date, the focus has been at the national level with recommendations directed at improving productivity, industry incentives, industrial preparedness management, the strategic stockpile, and other necessary actions. These initiatives are essential, but should be a part of an integrated effort that starts with the development of defense systems and initial decisions made in the program management office (PMO).

This paper will provide those associated with the acquisition process an understanding of the industrial base problem and the impact the PMO can have on the nation's ability to meet surge and mobilization requirements. Decisions made early on in the development of a system could help avoid some of the serious problems we face now. Above all, the PMO would be acquiring, within cost and on schedule, a supportable system that meets performance requirements and that is capable of being produced in the required quantities in times of national crisis.

Defense Industrial Base Problem

A look at representative items procured by the armed services during World War II, as shown in Figure 1, raises the eyebrows of many in the acquisition community. Those accustomed to the low-rate production inherent in today's systems wonder if such wartime output is possible today.

Some have been heard to say that with enough money, the production lines could be started again and Rosie the Riveter rehired. A few even believe the nation could achieve those WW II rates of 50,000 aircraft, 20,000 tanks, 80,000 artillery pieces, and 500,000 trucks per year.¹ An examination of our industrial base clearly shows that this kind of production is impossible today, even if the American industry and work force were mobilized. Whether such numbers would be required in a national crisis is another debate, but let us focus on the industrial base issue so the PM can understand the problem and its implications.

There have been numerous studies and papers written on the current status of our defense industrial base. Concern was evident in a report by the House Armed Services Committee on December 31, 1980. The title, "The Ailing Defense Industrial Base: Unready for Crisis," sums up the overall mood that prevails in government and industry. The chairman of the HASC Defense Industrial Base Panel, Representative Richard H. Ichord, stated in the letter of transmittal:

The panel finds that there has been a serious decline in the nation's defense industrial capability that places our national security in jeopardy. An alarming erosion of crucial industrial elements, coupled with a mushrooming dependence on foreign sources for critical materials, is endangering our defense posture at its very foundation.²

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Industrial mobilization would require effective use of all manufacturing skills and resources.

Examining these areas mentioned by Representative Ichord gives a clear picture of the nature of the problem. First, the erosion of crucial industrial elements is apparent if we examine lead times, the supplier base, manpower, productivity, and manufacturing technology (MANTECH). It is not my intention to cover each of these in detail, but I hope the major points presented here will give the reader an understanding of the magnitude of the problem. I will also discuss what the acquisition community can do to assist in the solution. A good starting point for the analysis is an area that has a major impact on our acquisition process today.

LEAD TIMES

Lead times continued to increase into 1980 for many system components. There were various reasons for the increase, to include:

- Inadequate capacity
- Competition for commercial products
- Raw materials shortage

The increase from 1978 to 1980 in selected material lead times is shown in Figure 2. These figures represent an in-

Figure 1. REPRESENTATIVE ITEMS PROCURED BY ARMED SERVICES DURING WORLD WAR II

MAJOR WEAPON SYSTEMS

10 battleships
27 aircraft carriers
110 escort carriers
45 cruisers
358 destroyers
504 destroyer escorts
211 submarines
310,000 aircraft
88,000 tanks

WEAPONS

411,000 guns and howitzers
750,000 rocket launchers and mortars
2,680,000 machine guns
12,500,000 rifles and carbines

FOOD SUPPLIES

2,000,000 tons of potatoes (Army)
2,880,000 tons of flour (Army)

AMMUNITION

29,000,000 heavy artillery shells
100,000 16-inch naval shells
645,000,000 rounds of light gun and howitzer shells
105,000,000 rocket and mortar shells
40,000,000,000 rounds of small arms ammunition

TRANSPORTATION EQUIPMENT

46,706 motorized weapons carriages
806,073 two-and-one-half ton trucks
82,000 landing craft
7,500 railway locomotives
2,800 transportable road and highway bridges

COMMUNICATIONS EQUIPMENT

900,000 radios (Army)

CLOTHING

270,000,000 pairs of trousers (Army and Navy)

dustry average of selected contractors. Recently there has been a favorable trend toward reduced lead times. This trend is attributable to reduced commercial demand, and some expect the lead times to increase as commercial and defense spending increases. To the PM, these lead times mean long-range planning is needed to avoid the bottlenecks in a normal peacetime environment. In a surge or mobilization situation, the problem will remain, because it is deeply rooted in raw materials, the supplier base, and many other interrelated factors.

SUPPLIER BASE

The Defense Science Board highlighted the problem with the basic materials, forgings, castings, and machine tools industries. Some of the significant findings were as follows:³

—The steel industry is in trouble as a result of aging plants, foreign competition, and environmental restrictions. Alloying elements such as chromium, cobalt, etc., are in short supply.

—During the period 1977 to 1979, the number of titanium fabricators dropped from 16 to 4, primarily as a result of titanium sponge shortage.

—In the past decade more than 400 foundries have gone out of business.

—The machine tool industry is characterized by a large number of small companies, most of which have no in-

terest in defense business and will avoid it if possible.

There are numerous factors that have caused the reduction in the defense supplier base. The primary reasons include economic conditions, material shortages, foreign competition, and government regulations. The net result to the PM is fewer companies in the marketplace, some loss of competition (with all that entails), and a possible increase in lead times. The implications in periods of surge or mobilization are obvious as numerous defense systems place demands on a few suppliers.

MANPOWER

Manpower shortages are also prevalent in industry. Specifically, it has been estimated that the nation will be short 250,000 machinists in the next 5 years.⁴ Also, it has been pointed out

that the nation should not expect the problem to be cured under mobilization conditions. During WW II the nation effectively mobilized its work force, but the systems of WW II are not those we're building today. Current weapon sophistication will require more training to produce the items. Harry Gray, Chairman and CEO of United Technology Corp., stated, "It takes the better part of a year to retrain someone from producing autos, for example, to work on high-technology aerospace parts."⁵

The modern machines in use today, coupled with close tolerances required for manufacturing, do not lend themselves to a short, crash-training program. Industry is short of trained personnel now, and once again this problem will be aggravated in the early months of surge or mobilization.

Figure 2. MATERIAL LEAD TIME

| | Dec 78 | May 80 | Apr 82 |
|---------------------------|--------|--------|--------|
| Aluminum Small Forgings | 48 | 83 | 44 |
| Aluminum Extensions | 54 | 81 | 26 |
| Titanium Large Forgings | 74 | 121 | 60 |
| Titanium Extensions—Heavy | 47 | 80 | 35 |
| Fasteners—Non-Titanium | 40 | 52 | 23 |
| Integrated Circuits | 34 | 44 | 40 |
| Diodes | 26 | 33 | 28 |



PRODUCTIVITY

This topic has received widespread attention. It is well known that U.S. industry is not keeping pace with other major industrial nations. From 1960 to 1978, U.S. productivity grew at an overall rate of 2.8 percent. In comparison, Great Britain grew at 2.9 percent, Canada at 5.4 percent, France at 5.5 percent, Italy at 5.9 percent, Belgium at 6.9 percent, the Netherlands at 6.9 percent, and Japan, the current hero of productivity, at 8.2 percent.

Poor productivity manifests itself in many areas, but specifically in costs. An Air Force Systems Command study concluded:

Manufacturing costs are about 42 percent of direct costs on a typical production contract. About 50 percent of this cost represents non-productive labor caused by inefficiencies of one kind or another. If it were possible to achieve only a 20 percent improvement in labor productivity, approximately one billion dollars could be saved on contracts at 11 of the major Air Force contractors.⁶

These are significant cost savings! Low productivity increases costs, decreases quality and contractor profit and, hence, diminishes investment. Capital investment is required for a strong industrial base. Thus the emphasis at the national level on improving productivity is necessary and will have short- and long-term effects on the PM's program.

MANTECH

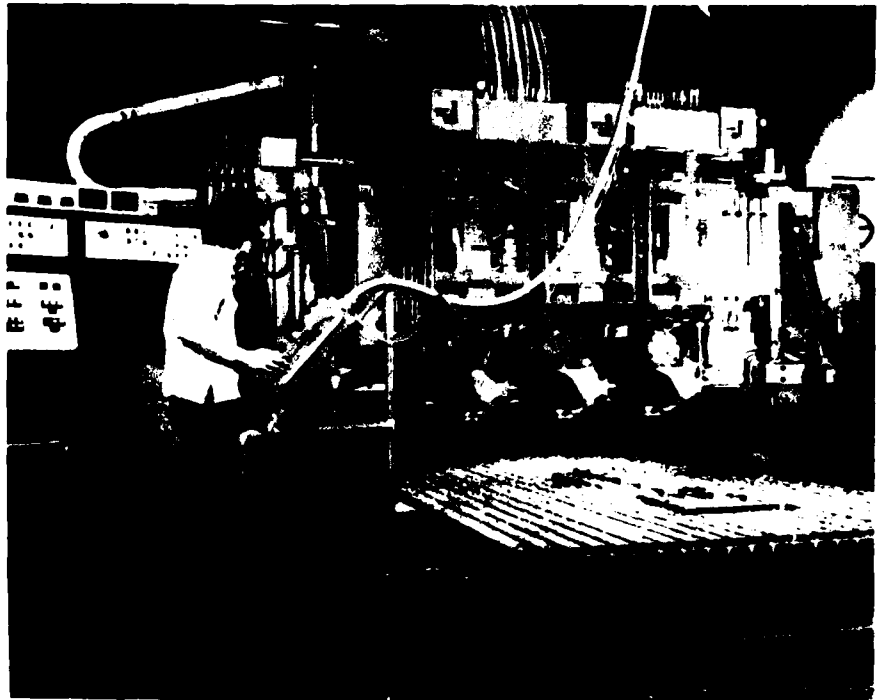
To further emphasize the lack of capital investment, studies have shown that much of the defense production

An employee aligns a photomask with a pattern previously etched on a silicon wafer. Exposure to light passed by the mask helps define the metal pattern on top of the wafer so that active areas can be contacted and connected to other elements of a circuit.

equipment available is over 20 years old and is inefficient.⁷ Furthermore, investment by defense industry lags behind the industry investment in the rest of the economy. As an example, during the past decade, the aerospace industry in the United States invested approximately 2 percent of its sales in new capital, whereas the average rate of investment for all U.S. industry during the same period was approximately 8 percent.⁸

New procedures and manufacturing technology programs require investment. Otherwise, productivity and quality could decline and we are back in the downward spiral mentioned earlier. Robotics and other improved machines and processes that increase production capability are not rapidly coming on line in defense industry, if at all, and the industrial base is further weakened as a result.

A Boeing Aerospace Company machinist operates this state-of-the-art three-spindle, five-axis Cincinnati Milacron Machining Center which is profiling an Air Launched Cruise Missile wing.



Boeing Aerospace Company

Having highlighted the critical industrial elements, I would like to turn to the dependence on foreign sources for critical elements. This trend has been noticeable, and is related to the problems with the industrial base that have been presented.

Critical Materials and Components

There is a growing dependence in defense industry on materials and products from foreign countries. The dependence ranges from relying entirely on imported minerals to using electronic components in our weapons systems that are manufactured abroad.

Figures 3 and 4 provide the data on U.S. dependence on foreign minerals. Figure 3 indicates the uses of raw materials in various weapon systems. Figure 4 shows how much the United States imports the various minerals and the sources. It is disturbing to realize that much of the world's production and resources of a number of our critical materials is located in Siberia and southern Africa.

The critical materials stockpile is not at established goals. Of the 62 family groups and individual materials that are to be stockpiled, about 60 percent do not meet the goals. A sample of five of the minerals is shown in Figure 5.

As mentioned previously, the U.S. defense industry has become dependent on foreign sources for materials

Figure 3. MATERIALS AND SYSTEM APPLICATIONS

| | SYSTEM APPLICATION | | | | | | | | | |
|----------|--------------------|------------------------------|-------------|----------|---------|------------|-------|------------|----------------|------------------|
| | Aircraft | Electronic/Optical Equipment | Helicopters | Missiles | Weapons | Simulators | Ships | Submarines | Test Equipment | Armored Vehicles |
| MATERIAL | Aluminum | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | Asbestos | ● | ● | ● | ● | | ● | ● | | ● |
| | Beryllium | ● | | | ● | | | | | |
| | Cadmium | ● | | | ● | | | | | |
| | Chromium | ● | | ● | ● | | ● | ● | | ● |
| | Cobalt | ● | | ● | ● | | ● | ● | | ● |
| | Columbium | ● | | ● | | | ● | ● | | |
| | Copper | ● | ● | ● | ● | ● | ● | ● | | ● |
| | Magnesium | ● | | ● | ● | | ● | ● | | ● |
| | Manganese | ● | | ● | | | | | | |
| | Mica | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | Molybdenum | ● | | ● | ● | | ● | ● | | |
| | Nickel | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | Platinum | ● | ● | | ● | | ● | ● | | |
| | Tantalum | ● | ● | ● | ● | | ● | ● | | |
| | Titanium | ● | | ● | ● | | ● | ● | | |
| | Tungsten | ● | | ● | ● | | ● | ● | | |

Source: Doty Associates, Inc., Study of Increasing Lead Times in Major Weapon Systems Acquisition (1981).

and components. Japan has taken almost half of the U.S. market for the computer memory chip, and Japan is posing a serious threat to the U.S. semiconductor industry. Also, it was observed by the HASC panel that approximately 90 percent of all assembly work on U.S.-manufactured semiconductor devices is being done offshore.⁹

What Can We Do?

The previous discussions brought out some key factors concerning the state of the defense industrial base. The base is recognized as ailing and in need of help. Now the question becomes: What can the acquisition community do to integrate into the national efforts

directed at these problems? I think there is a lot we can do—and must do. Our efforts must be guided by current policy or the policies need to be changed to ensure proper emphasis.

DOD INITIATIVES

In the past, DOD policy did not adequately address surge and mobilization considerations during the entire acquisition process. The Defense Science Board indicated that there was a lack of focus and emphasis within DOD on industrial responsiveness and preparedness.¹⁰ This deficiency has been addressed and is receiving increased attention. Dr. Richard D. DeLauer, Under Secretary of Defense for Research and Engineering, established a DOD Task Force to Improve the Industrial Base. The task force recommended changes to DOD policy, which incorporated many of the recommendations made in previous studies. The new DODD 5000.1, dated March 29, 1982, contains guidance for considering industrial base issues. Also, DODI 5000.2, under revision at this time, hopefully will incorporate additional policy guidance. It is essential that all appropriate documents reflect this emphasis. This includes, as a minimum, DODD 5000.34, "Defense Production Management"; 5000.38, "Defense Production Readiness Reviews"; 7200.4, "Full Funding of DOD Procurement Programs"; and 4200.15, "Manufacturing Technology Program."

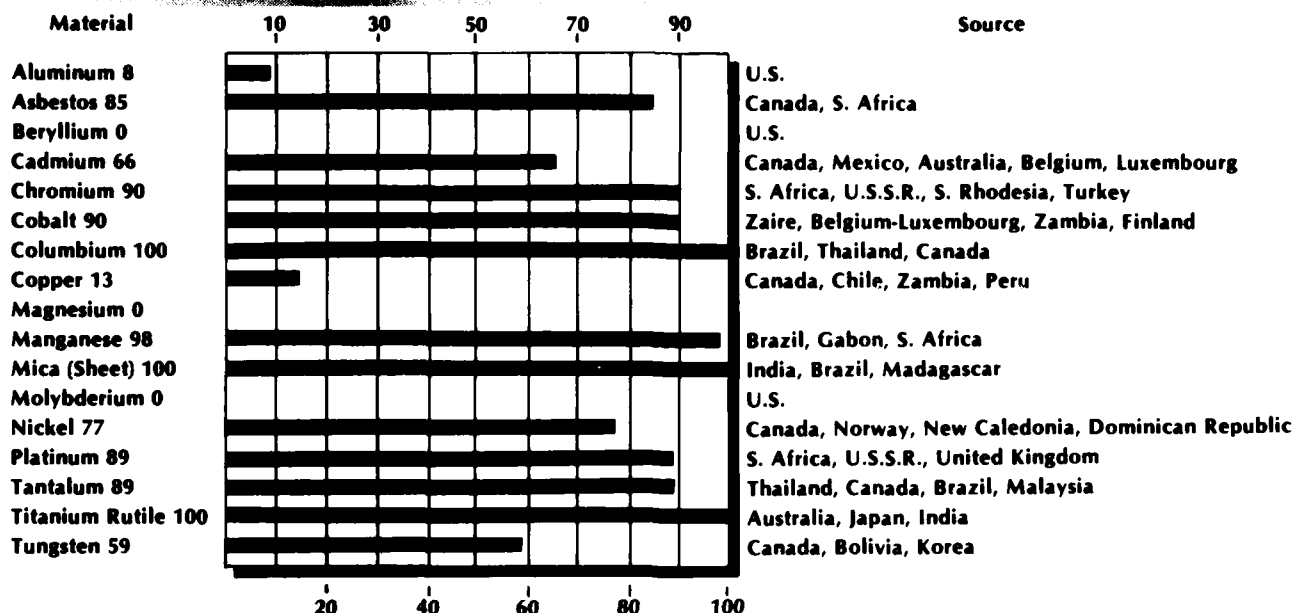
Another major action taken by OSD was to draft and publish changed industrial preparedness defense guidance. This guidance established clearly defined industrial preparedness objectives that can be used to increase the capacity and responsiveness of the industrial base.

These initiatives are in the form of policy guidance. As mentioned previously, the subject of industrial preparedness touches many levels of government and civilian organizations. Let's get back to the prime focus of this discussion, the PM and his office, and look at those actions that can and should be taken now.

What the PM Can Do

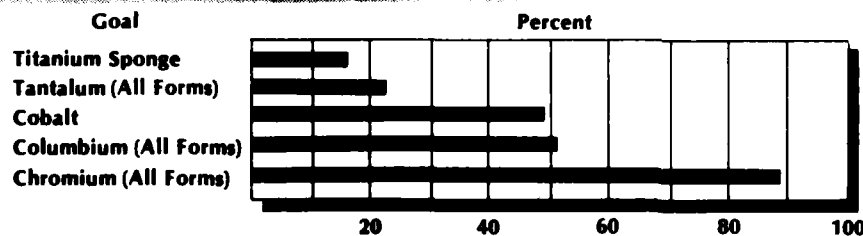
The first thing a program manager must do is genuinely recognize his long-term mission to acquire for the government a piece of equipment that may have to be produced at increased rates during a period of national crisis

Figure 4. U.S. RELIANCE OF SELECTED MINERALS AND METALS AS A PERCENT OF CONSUMPTION IN 1979



Source: Report of the Defense Industrial Base Panel: "The Ailing Defense Industrial Base: Unready for Crisis."

Figure 5. PERCENT OF STOCKPILE INVENTORY VS. GOALS FOR SEVERAL MATERIALS



Source: U.S. Air Force, "The Air Force Systems Command Statement on Defense Industrial Base Issues," November 13, 1980, pp. III-13.

or conflict. All too often the acquisition community considers only cost, performance, schedule, and supportability in terms of today's problems. This is understandable as we face the day-to-day situations that arise, but let none of us forget why we are building the equipment in the first place. The acquisition community builds equipment to prevent or fight a conflict. Each day we must fight the battles of cost, performance, schedule, and supportability within the framework of our overall long-range goal.

The PM must next understand the industrial base with its problems and vulnerabilities. This paper has presented some of the common and more significant problems. Courses offered

at the Defense Systems Management College in the Program Management Course cover the industrial base, and the press has given the subject wide coverage. This understanding is essential, because industrial base problems are affecting our programs now, especially in the areas of cost and schedule. What is equally important is the effect a weak industrial base will have on the ability to surge or mobilize the particular system at some point in the future. Thus, having recognized his overall mission and having gained an understanding of the industrial base, the PM can take steps to improve the posture of his system. These improvements will have both short- and long-term benefits.

The importance of good planning is obvious, and the appeal here is to include surge and mobilization considerations early in the program planning. This is not limited to purely manufacturing considerations, but should start with system requirements and design.

Requirements form the basis for the acquisition community undertaking the development of a system. An RFP is released that tells industry, among other things, what the user needs and establishes specs/standards and selection criteria. Producibility must be adequately emphasized in the RFP to include an emphasis on using readily available materials and components that would reasonably be available in a time of crisis. With the PM and industry recognizing the nature of the potential problems, trade-offs will be made early in the design. Producibility will gain added emphasis if made a part of source selection.

If problems are encountered in meeting requirements vs. producibility, the user must be advised of the implications and alternatives. As an example, if an engine, in order to meet requirements, must use a strategic metal, this fact must be recognized. The contractor should propose alternatives with the final decision being reached

by the PM and user. It would be beneficial if the user were also well-versed in the industrial base and the implications of relying on foreign material or strategic metals. If the user isn't well versed, then it is up to the PM to educate him.

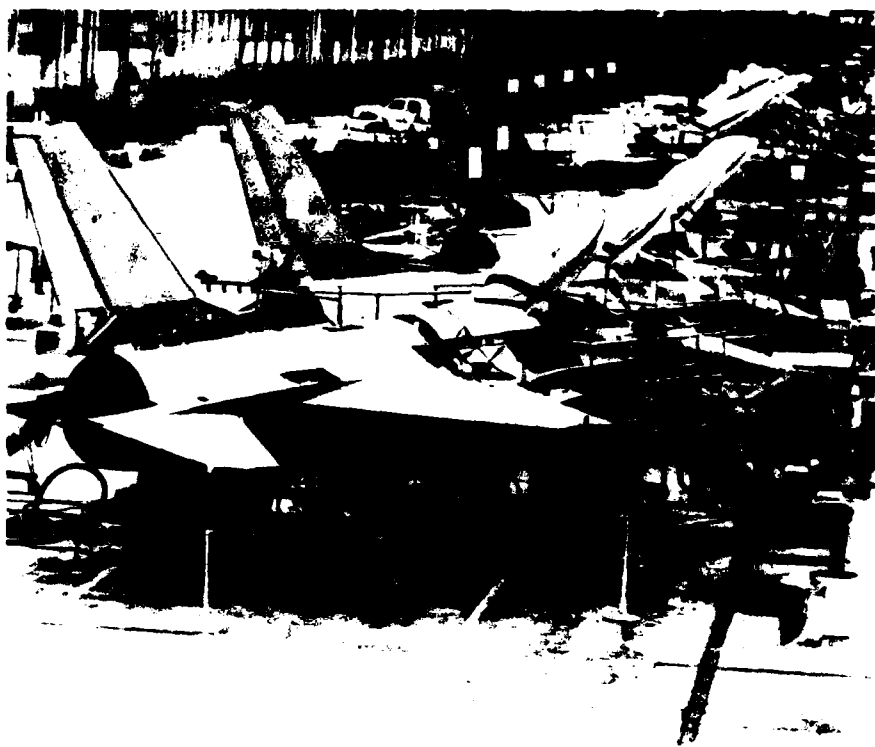
User involvement is crucial in another aspect. An early decision must be made on whether to require surge and mobilization capacity. A strategic satellite system will have to be producible, but there may be no requirement to surge the system. On the other end of the spectrum are fighter aircraft and tanks. Various contingency plans have requirements for these systems and many others, depending upon the scenario. When the requirement for surge and mobilization is defined early on, the PM should consider how it can be met from a system design standpoint.

Should the design require the use of critical materials, the PM has several alternatives. He must ensure his higher headquarters is aware of the material requirements so that appropriate industrial preparedness planning can be accomplished. The defense priority system, defense materials system, and the national stockpile are all affected by program requirements. These systems need improvement themselves and initiatives have been identified at the national level.

The PM can also use the labs or the contractor to examine material substitutes. To date, the exotic alloys have been used as required. Labs and contractors need to work on substitutes that would use materials the United States could count on having during a crisis. What is required is a search for new alloys, not only because of performance characteristics, but also from an availability standpoint.

Implied in the previous discussions is a knowledge by the PM of where the materials and components for his system come from. This will require that the contractor know the status down to the lowest supplier level. It would not be sound to have a critical component or material for a weapon system with surge and mobilization requirements manufactured in a country that could easily be cut off as a supplier.

Another area the PM can influence is MANTECH. Recommendations on future needs to achieve better producibility and productivity can be sub-



General Dynamics

mitted. The PM can also work with the contractor in the MANTECH area and possibly provide contract incentives for improvements. This initiative would have short- and long-term benefits. Productivity and quality could improve, and the need for short-supply labor skills could possibly be reduced.¹¹

Also related to the manpower problem is the requirement that the PM consider training during surge and mobilization. This covers training required to increase production as well as training to operate the system. The PM needs to know how long it would take to train the increased work force at the contractor facility. This would be at the prime and subcontractor levels, depending upon what are considered to be the pacing items. As mentioned earlier, training requirements can be lengthy for modern equipment manufacturing to close tolerances. As an example, it would require approximately 12 months to train the additional work force to reach 150 M-1 tanks per month.¹²

The PM must also consider training of operations and support personnel. The time it takes to train new personnel during a period of crisis must be known and minimized. This is important in system design and in the development of the training system. Good training devices that can also be

The F-16 is produced at General Dynamics' Fort Worth plant.

used in a period of mobilization must be developed.

In spite of the PM's attention, problems may still arise that are beyond his control in the area of surge and mobilization. For example, funding for facilitation may be not adequate, long-lead items adversely impact on his system, or critical materials have to be used to meet requirements. In these cases, the PM can only provide decision-makers with the information to assess the risk and make decisions. There may be alternatives such as pre-stocking long-lead items or critical materials to ensure their availability. Once again, however, the question of funds will arise and can only be answered when compared to risks.

Any actions a PM takes must be part of an integrated effort. Previously mentioned were the efforts at the national level and an overall lack of DOD policy in the acquisition arena regarding industrial preparedness. Department of Defense policy changes must be implemented to ensure industrial preparedness as it relates to individual programs.

Conclusion

This paper has focused on the most vital link in the acquisition process, the program manager. The industrial base issues were developed to give the reader an understanding of the problem and to develop an awareness of the long-term producibility considerations. The industrial base in the United States is ailing for a number of reasons, which were discussed. National initiatives are aimed at improving the situation. The PM can do his part by making design trade-offs and doing adequate planning early in the program to facilitate producibility during surge or mobilization. Department of Defense policy needs to ensure that the entire acquisition community is coordinated and that necessary management and budget decisions can be made. It is true that the budget determines how much facilitation, stockpiling, etc., can be done. The PM, however, must ensure that planning is done, that information is provided, and that he influences system design by making trade-offs between performance and producibility.

The PM thus becomes a vital part of an overall national effort to improve our industrial base. More importantly, he is developing a system that can be produced in required quantities in peace or in war.

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M-1 tanks in a test and evaluation exercise.

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4. "The Ailing Defense Industrial Base: Unready for Crisis," p. 14.

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12. Industrial College of the Armed Forces, *Defense Industry Analysis Summaries*, National Defense University, Washington, D.C., May 1981, pp. 7-17.

Thayer Comments on Systems Acquisition

we are going to make some mistakes and have to retrench, we could cut 2 years off a major program. And there's a lot to be said, as all of you in uniform know, for getting a system into the hands of the operator where he can figure out things to do with it that the planners didn't think of.

Logistics Support

But I want to do all of this with a high priority, which has been established and which I fully support, on readiness, sustainability, and training, because regardless of what you put out in the field, even if it is the finest piece of equipment in the world, if you haven't the right guys to run it, it's not worth a damn!

(Continued from page 3.)

The Honorable W. Paul Thayer took the oath of office as Deputy Secretary of Defense on January 11. He replaces Frank C. Carlucci, who resigned in December 1982.

Mr. Thayer comes to the Department of Defense from industry, where he held high-level executive positions for nearly 30 years.

He was Chairman of the Board and Chief Executive Officer of LTV (Ling-Temco-Vought) Corporation from 1970 until his appointment as Deputy Secretary. He also served as Chairman of the Chamber of Commerce of the United States, and on the board of the Business Roundtable.

After serving in the U.S. Naval Air Corps during World War II in the Pacific Theater, Thayer became a TWA pilot briefly and then a commercial test pilot for then Chance-Vought Aircraft and Northrop. He joined the corporate structure of Chance-Vought in 1955 by becoming Vice President for Sales and Services and a member of the Board of Directors. He was promoted to President of the reorganized (LTV) Corporation in 1965 and Chairman of the Board in 1970.

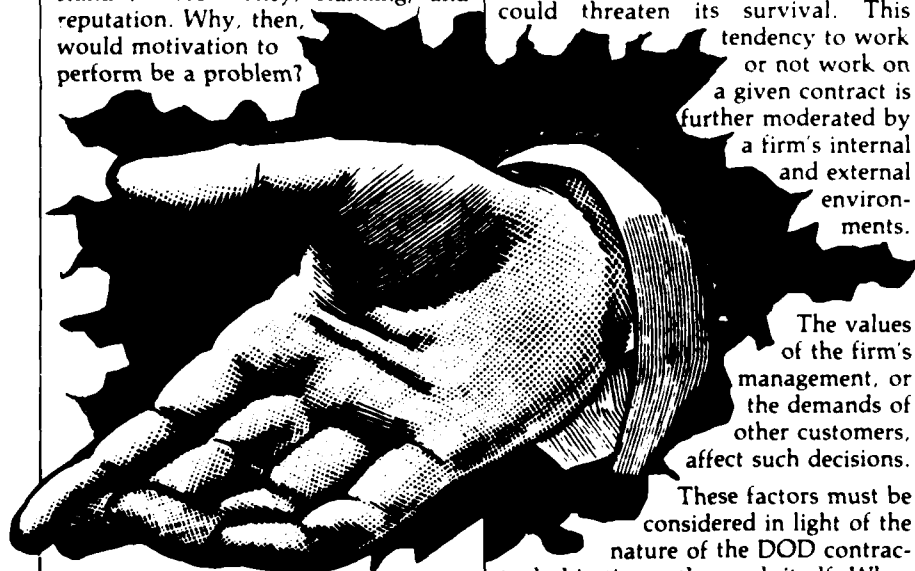
He attended the University of Kansas, majoring in petroleum engineering.

The new deputy secretary is married to the former Margery Schwartz, and they have one daughter, Brynn.

The Department of Defense (DOD) must go to the private sector to obtain its new products. If the private-sector contractor doesn't perform, it is particularly troublesome to DOD because, unlike an industrial buying firm, it has no capability to make a product in-house, and has considerable difficulty moving to a new source. Moreover, because DOD has critical deadlines and buys relatively complex products in relatively small lot sizes, and with stringent quality requirements, the problem of nonperformance is all too real.

Contractor Motivation

But beyond the question of whether a firm *can* perform is the question of whether it *will*. Many government managers charge that defense contractors are often not motivated to perform well on a contract. To some, this may seem like a strange allegation. The firms did come forward to do the work; they did agree to do it for a stated amount of money in a binding contract. If they do not perform, they stand to lose money, standing, and reputation. Why, then, would motivation to perform be a problem?



To understand this phenomenon, we must analyze the contractual relationship between the government and the contractor. In Figure 1, which is one representation of the relationship, the two parties are shown exchanging behaviors—most prominently money for performance—in a contract. Both parties exhibit behavior that is a function of (1) their own objectives; (2) the other party's objectives; (3) their internal environment (factors that dictate

how the organization will react to the external environment); and (4) the external environment.

The reason, therefore, that motivation is a salient issue in contract performance is that the contract (i.e., government objectives) is just one set of forces, albeit a primary one, that acts on contract performance. All other things being equal, a firm would, of course, tend to perform on a contract it had just signed. However, the firm has, as a higher order, its own set of objectives and is first motivated to maximize its own benefit-cost ratio.¹ A firm may, for example, find the ratio higher for the performance of one contract than for a second one in its plant at the expense of the second, or it may find that completing a government contract could threaten its survival. This tendency to work or not work on a given contract is further moderated by a firm's internal and external environments.

The values of the firm's management, or the demands of other customers, affect such decisions.

These factors must be considered in light of the nature of the DOD contractual objectives—the work itself. When a firm gets a DOD contract for a complex new product and finds that substantial resources must be employed to accomplish the contract objectives, the start of a "motivational" problem may be at hand.

Research Study

Because of speculation of such issues as these, the Army Procurement Research Office was tasked to undertake

So, what does the really

Dr. Robert F. Williams

a study on contractor motivation.² This study attempted to identify motivational practices to improve contractor performance, and constraints on the use of these practices.

On the basis of preliminary interviews and literature reviews, questionnaires were designed around the hypotheses formed. Seven-point semantic differential scales were used to gauge response. For example:

"Rate the *relative* effectiveness in your firm of:

A. Award Fees:

Very Strong _____: _____: _____: _____:
_____: _____: Very Weak: _____

Classification questions were used to give more insights into the responses. Open-ended questions asked for responses not contemplated in the closed-end questions.

The government questionnaire was mailed to a structured sample of Army procurement personnel. The industrial questionnaire was sent to members of the National Security Industrial Association (NSIA). Rankings on the elements of the model (e.g., incentives) were made for each sample (government and industry). The relative perceived priorities of government objectives, the relative effectiveness of government incentives, and so on, were ranked by both government and industry. Rankings were then made for the various groupings in each sample (e.g., by type of organization or size of organization). Other analyses, such as the correlation between contractor objectives and effective incentives, were made. Judgments were made on relative strengths and weaknesses of the

■ Dr. Williams is Chief of the Test and Evaluation Group, Army Procurement Research Office, Fort Lee, Va. ■

defense contractor want?

element responses (e.g., award fee *vis-a-vis* incentive fee) for the two samples (t-tests and ANOVA tests), and within the various groupings. The strength of response reliability was inferred from the related response of similar groupings (e.g., R&D organizations vs. organizations having R&D contract emphasis), and from responses to related questions (e.g., profit as an objective of a firm vs. profit as an incentive to that firm). Findings from the literature, interviews, and open-ended portions of the questionnaire were introduced for the model elements. Validity of the questionnaire results was judged by comparison to the results from these other sources. Based on a synthesis of all the findings, inferences toward the hypotheses were made.

Defense Contractor Objectives

Contractor objectives have been the subject of numerous studies.³ Researchers have found that firms have, indeed, more objectives than just profit. This, of course, is a main hypothesis of this study—on a given contract, a contractor could have any of a number of objectives in mind; and the study would seek to find out how to satisfy the given objectives (assuming they are not detrimental to the government's interests) in order to better complete the contract. I should point out that the study asked about *contractual* objectives which, while drawn from, are not necessarily the same as corporate objectives.

Table I shows the samples' responses on defense contractual objectives. Government personnel perceived the order of importance of industrial objectives to be (in very close order) profit on sales, company survival, improved cash flow, development of dominant industry position, and return on investment (ROI). These were followed by company growth, and pro-

vide a good product. Public image was perceived last.

Industry beliefs about its objectives were quite different. Industry personnel felt that providing a good product was by far the most important objective, followed by maintaining a long-term continuing business relationship, and then improved cash flow, profit, and development of new capabilities. Use excess capacity was the last-rated objective, with public image next to last. Profit and indirect profit objectives were understandably near the top here: but perhaps just as important, government and industry personnel differ significantly on five of the stated objectives. Although industry said its most important motive is to provide a good product, the government perceived this motive as far less important. Industry felt a long-term business relationship was far more important than did government. Industry considers the development of new capability to be more important than does the government.

On the other hand, the government perceived that using excess capacity was much more important to industry than industry expressed.

Company survival was perceived as a stronger motive by government than by industry. Again, the difference in perceptions is worthy of study.

Although establishing a long-term business relationship will be difficult in view of current statutes in competition, it is possible that industry's desire to provide a good product and develop new capability can be better used in government planning than is now being done. The appeals to use excess

capacity, and to help companies survive will have to be used more selectively.

There were also significant differences in various sub-groupings. Government managers perceived company survival to be less important than did non-managers. Research and development activities saw the development of new capability, maintaining a long-term business relationship, and establishing a dominant industry position as more important motives to industry than did readiness activities. Organizations having technically competitive contracts perceived a dominant position as more of an industrial objective than did other organizations. Organizations dealing with small organizations perceived company survival and the use of excess capacity as more important than did organizations dealing with larger firms. Government activities emphasizing production contracts saw profit and improved cash flow as stronger motives than did R&D contracting personnel. However, those having R&D contracts found development of new capability and dominant industry position more important to industry than did production personnel. Government personnel working with highly competitive

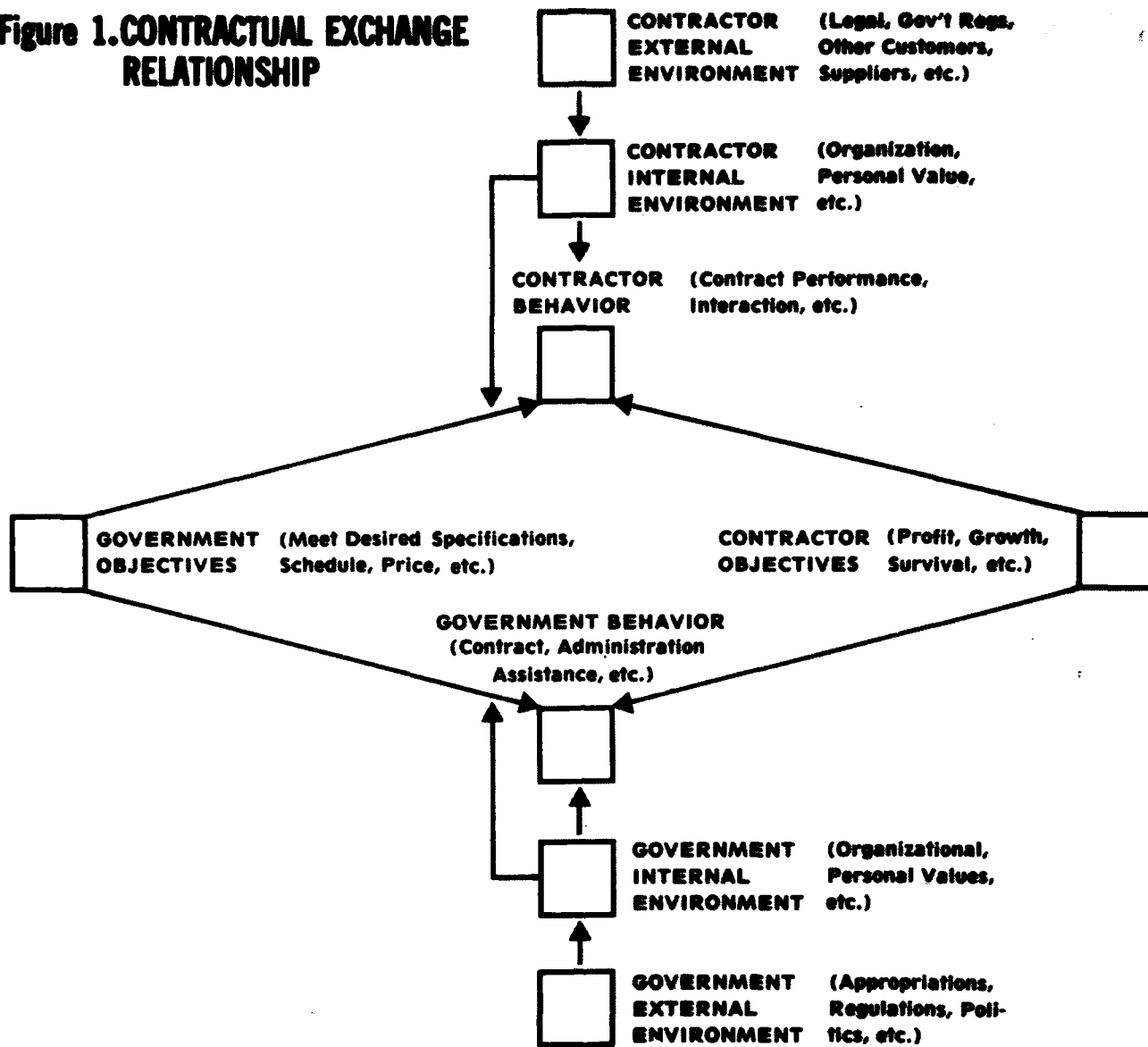
industry perceived establishing a dominant industry position as a stronger motive than did other government personnel. The higher

the technical competition they dealt with, the higher the likelihood government personnel perceived the importance of the development of new capability, development of a dominant industry position, and establishment of a long-term business relationship.

Small firms expressed far more concern for company survival than did larger firms. Growing firms expressed a higher use for profit and ROI than did rapidly growing and mature firms.



Figure 1. CONTRACTUAL EXCHANGE RELATIONSHIP



Labor-intensive firms had the most regard, balanced firms the second most, and capital intensive firms the least regard for providing a good product, company survival, developing a skilled work force, developing new capability, establishing a long-term business relationship, and improving cash flow. Industrial and divisions firms with more government business expressed somewhat more utility for company survival, company growth, and improved cash flow than did other firms. Firms with publicly held ownership showed far more interest in company survival and development of a skilled work force than did closely held firms. Production firms selected use of excess capacity as a stronger motive than R&D firms did. Highly technical-

ly competitive firms valued public image more than did other firms.

While many of these relationships are intuitively obvious or potentially spurious, it is felt this list of findings can be useful for buying strategy development, and for suggestions toward further research.

Government Incentives and Disincentives

If an incentive is any practice that will improve a contractor's motivation to perform, then the list of these practices is a long one. In the design of this questionnaire, the most commonly raised practices from the preliminary research were chosen as response alternatives. Note that the list of 22 incen-

tives can be broken into the groupings of contract type, contract provisions, and extra contractual practices.⁴ The open-ended responses in the last part of the questionnaire served to augment the responses to the given list of alternatives.

Table II summarizes the feelings about the relative effectiveness of government incentives.

Government employees feel by far that the most effective incentive is a guarantee of future business for a firm, followed by program continuity, then profit, fair and equitable contracts, and competition. Government employees felt the weakest incentives were non-monetary awards and performance bonds, followed by possibility of

Table I. DEFENSE CONTRACTOR OBJECTIVES

| Objective | As Perceived by Government Employees | As Perceived by Industry Employees |
|---------------------------|--|--|
| Good Product* | 2.90 (7) | 1.83 (1)# |
| Company Survival** | 2.43 (2)*** | 3.09 (9) |
| Company Growth | 2.84 (6) | 3.09 (9) |
| Profit on Sales | 2.41 (1)*** | 2.78 (4) |
| Invested Capital | 2.76 (4)*** | 2.88 (6) |
| Public Image | 4.11 (12) | 3.96 (11) |
| Develop Workforce | 3.28 (9) | 2.93 (8) |
| Utilize Capacity* | 3.34 (11) | 4.25 (12) |
| Develop Capabilities** | 3.33 (10) | 2.80 (5) |
| Long-term Relationships* | 3.12 (8) | 2.19 (2) |
| Develop Dominant Position | 2.74 (4)*** | 2.88 (6) |
| Improve Cash Flow | 2.66 (3)*** | 2.70 (3) |

*P .001 (Groups significantly different)

**P .01 (Groups significantly different)

***P .05 (Significantly different from 6th and lower)

#P .025 (Significantly different from rest)

Table II. EFFECTIVENESS OF GOVERNMENT INCENTIVES

| Incentive | As Perceived by Government Employees | As Perceived by Industry |
|--|--|-----------------------------|
| High Profit | 2.64 (5) | 2.34 (5) |
| Award Fees*** | 4.01 (17) | 3.23 |
| Incentive Fee*** | 3.66 | 3.09 |
| Multiple Incentive Fee** | 4.19 (18) | 3.27 |
| Improved Cash Flow | 2.64 (4) | 2.41 (6) |
| Program Continuity** | 2.41 (2) | 1.89 (3)# |
| Guarantee of Future Business | 2.06 (1)* | 1.88 (2)# |
| Long-term Funded Contract | 2.50 (3) | 2.48 (7) |
| Evaluation of Past Performance*** | 3.74 | 3.12 |
| Capital Investment Protection | 3.10 | 3.00 |
| Non-monetary Awards | 4.89 (21) | 5.26 (22) |
| Government-funded Capital Investments | 3.46 | 3.93 (20) |
| Competition | 2.80 (7) | 3.01 |
| Withholding of Future Business | 3.40 | 3.29 |
| Monetary Loss for Poor Performance | Omitted | 3.59 (18) |
| Termination | 4.20 (19) | 3.91 (19) |
| Performance Bonds | 4.89 (21) | 4.88 (21) |
| Possibility of Competing Next Contract | 3.18 | 2.90 |
| Good Working Relationship** | 3.50 | 2.58 |
| Appropriate Contract Type** | 3.01 | 2.04 (4)# |
| Fair and Equitable Contract** | 2.78 | 1.87 (1)# |
| High-level Management Contract | 3.90 (16) | 3.57 (17) |

*P .0001 (Significantly different from those below)

**P .001 (Groups significantly different)

***P .01 (Groups significantly different)

#P .025 (Significantly different from 5th and below)

default, multiple incentives, award fees, and "jawboning." ("Monetary Loss for Poor Performance" was omitted from the government questionnaire, but this incentive has historically been a low-rated alternative in government buying.)

Industry felt the four strongest incentives were a fair and equitable contract, guarantee of future business, program continuity, and appropriate contract type. Profit, improved cash flow, and long-term funded contracts were next in importance. Industry indicated the lowest regard for non-monetary awards and performance bonds, followed by government-funded capital investment, possibility of default, monetary loss for poor performance, and "jawboning."

Industry and government personnel disagreed on the effectiveness of 8 of the 21 factors compared. Industry felt the following were significantly more effective than did the government: award fees, incentive fees, multiple-incentive fees, program continuity, evaluation of past performance, good working relationship with government personnel, appropriate contract, and fair and equitable contract type. The government felt somewhat more strongly that government-funded capital investment was more important. Industry's low response on monetary loss for poor performance is suspect (and worthy of more research) because of its own heavy use of the technique.⁵

Industry and government personnel agreed that future business (long-term profit) and high profit on a contract and cash flow (short-term profit) are effective incentives. There was also agreement that non-monetary awards, possibility of default, performance bonds, and "jawboning" are relatively ineffective. One might think that, because of the perceived strength of program continuity, the threat of default would be a strong motivator. Apparently, default is a "paper tiger" to all but very small businesses. Because performance bonds are largely a construction technique, they may not have "scored" well through lack of understanding. Most importantly, perhaps the government should re-evaluate the eight incentives that industry felt were more effective (award fees, incentive fees, multiple-incentive fees, program continuity, evaluation of past performance, good working relationship with government personnel, appropriate

contract, and fair and equitable contract type) and the one industry felt was less effective (monetary loss for poor performance).

The contract itself is the subject of five of the incentives. Incentive (even multiple incentives) and award fees were seen as effective by industry in spite of studies that show little empirical evidence of this effectiveness. As the Council of Defense and Space Industry Associations (CODSIA) questionnaire results indicate, however, this effectiveness is dependent on how well these complex pricing arrangements are structured.⁶ This interpretation is supported by industry's stronger feeling about appropriate contract type and fair and equitable contracts. In sum, it seems industry will be motivated by better contracts with better pricing arrangements from government. Another area seen by government personnel as a potentially good motivator and by industry as perfectly legitimate is the use of past performance. The Air Force is the leading service in using past performance as contractor-award criteria.⁷ Even though the government perceives program continuity as important, industry cited it as being *more* important. The potential for this incentive has to be tempered by the attendant loss of leverage by the government and, of course, the lack of mechanisms to ensure this continuity.

Significant differences were found in perceived effectiveness of incentives among the groupings of both samples. In the government sample, R&D activities felt that incentive fees, program continuity, guarantee of future business, government-funded capital investment, and the possibility of withholding future business (marginally) were more effective than did readiness activities. Offices emphasizing technically competitive contracts felt fair and equitable contracts and "jawboning" less effective than did other offices. Offices dealing with small firms scored evaluation of past performance, possibility of default (as predicted by previous research), and appropriate contract types higher in effectiveness than did offices dealing with large firms. Offices with R&D contracts felt more strongly about the perceived effectiveness of competition than did those with production contracts. Those with production contracts more often emphasized profit and possibility of default. Government personnel dealing with

more price competition featured the effectiveness of multiple incentives, possibility of termination, and "jawboning." Government personnel with higher technical competition perceived a higher regard by industry for competition, threat of competition, and good working relationship with industry. One unexplained difference was that government personnel who deal with technical competition scored the threat of default higher than those involved either in no technical competition, or in a high degree of technical competition.

Incentives and award fees were seen as effective in spite of the lack of evidence.

The industry sample also displayed interesting differences among groups. Smaller firms expressed more concern with program continuity and evaluation of past performance. Smaller divisions emphasized profit and a good working relationship with government personnel. Larger divisions were impressed with multiple incentives, long-term funded contracts, government-funded capital investment, and the possibility of competition. Low- to medium-technology firms showed more concern for evaluation of past performance and a good working relationship with government personnel than did high-technology firms. The questionnaire figures on firms experiencing different levels of growth were somewhat ambiguous: Although slower-growth firms appear to have more regard for incentive fees, intermediate-growth firms appear to emphasize improved cash flow and appropriate contract type more than do rapidly growing and mature firms. Capital-intensive and labor-intensive firms showed many differences. Labor-intensive firms (relative to balanced capital- and labor-intensive firms) felt the following were more effective: award fees, incentive fees, multiple incentives, improved cash flow, long-term funded contracts, evaluation of past performance, non-monetary

awards, and withholding of future business. Balanced-intensity firms had more interest in government-funded capital investment than did labor- or capital-intensive firms. Firms with more government business reacted more to the possibility of withholding government business. Divisions with much government business thought more of award fees, incentive fees, multiple-incentive fees, improved cash flow (marginally), non-monetary awards, possibility of withholding future business, appropriate contract type, and "jawboning." Closely held ownership was more responsive (than publicly held) to improved cash flow, program continuity, possibility of withholding future business, performance bonds, good working relationship with government personnel, and fair and equitable contracts. Attention to non-monetary awards increased with the degree of price competition. Firms in a highly technically competitive industry held more regard for award fees, multiple-incentive fees, improved cash flow (marginally), capital investment protection, and competition than did less-competitive firms. Again, there are too many findings for individual treatment, but this list does serve to suggest buying strategy and areas for further research.

Another alternative for assessing the perceived effectiveness of various government incentives is to correlate the responses of two samples on incentives with the responses on contractor objectives; that is, some industries expressing a high rating for a certain motive also have high utility for certain incentives. If the government knows a firm has this motive, then it might employ those incentives that correlate with it.

Table III summarizes the higher correlations for the government sample; Table IV for the industry sample. Only these top correlations (R_s) with a P less than .01 (that R is not zero) are used.

The tables show quite a difference of opinion on which incentive is effective with various objectives. In the main, the contractor responses make more intuitive sense. For example, industry data indicate that those firms that have "provided a good product" as a leading objective will respond well to evaluation of past performance, capital investment protection, non-monetary awards, competition, possibility of withholding future business, and a good working relationship with the

government. These responses are more realistic than the government's high responses on improved cash flow and program continuity. Perhaps industry's responses are better here because they are based on actual industry reaction; government responses are based on *perceived* industry reaction. Consequently, Table IV is probably of more use in selecting incentives; on the other hand, government perceptions in Table III should be given more investigation, because they can lead to poor choices of incentives.

Conclusions about Contractor Motivation

What, then, *does* the defense contractor want? There is no simple answer. Many may point out that while it is not difficult for an organizational entity to articulate a set of goals, it is quite another matter to perceive the "real" values of that organization.

We have tried to look at the issue in two ways—what industry says its objectives are, and which government incentives it says it will respond to. Actually, the two sets of responses match fairly well. Industry's top-rated objectives are to provide a good product (by far the highest) and to maintain long-term continuing business relationships. These objectives indicate more concern about long-term profit objectives than do the objectives rated third and fourth, improve cash flow and profit on sales, the nearer-term concerns. This is consistent with the top-ranked government incentives of guarantee of future business and program continuity, significantly ahead of the next ranking of high profit and improved cash flow. The other two top-ranked incentives, appropriate contract type and fair and equitable contract, also rank ahead of short-term profit indicators, and express the immediate concern for a straight-forward contractual relationship.

On the other end of the spectrum, industry gave lowest rankings to the probably more negatively connoted responses, enhance public image and utilize excess capacity. These rankings track with the last-ranked incentive, non-monetary awards. There appears to be insensitivity to the other lowest-ranked incentives, government-funded capital investments and performance bonds, techniques this group may be unfamiliar with. Apparently, industry does not "want" the things not readily translatable into profit impact.

Only three industry groupings show consistently wide differences in their responses—by manufacturing process, by division government business, and by ownership percentages. The differences in their environments must make the capital-intensive firm value different things than the labor-intensive firm; the large-government-business division values different things from the small-government-business division, and a publicly owned firm differs from the privately-owned firm. Government buyers should use these distinctions. More surprising was the finding that firms do not differ significantly by size or technology, or whether they deal in R&D or production.

Apparently, industry does not "want" the things not readily translatable into profit impact.

Government buyers tend to have ambiguous perceptions of the same objectives or wants in defense contractors. In terms of contractor objectives, they perceive profit on sales and improve cash flow, the short-term profit indicators, to be significantly higher than the longer-term profit indicators, provide a good product and establish a long-term relationship. This is the exact opposite of the industry rankings. Government personnel indicate that longer-term profit incentives are the three most important incentives of the list of 22, followed by short-term profit incentives. This match with industry is impressive, but overall there was disagreement of about 40 percent (13/34) on the combined objectives and incentives between the government and industry. From this we may conclude that the government is not quite sure what industry wants.

Suggested Actions

Defense buyers should generally assume that the three most pressing concerns of the contractor are long-term profit, short-term profit, and fair and appropriate contract formations. The first concern implies that the buyer should express interest in the contrac-

tor's continuity of business, much as industrial buyers do with their vendors. This interest can take the form of multiyear contracts and options, as well as increased attention to identifying the firm as a respected and valued defense contractor, not as a formless entity that happened to get a contract. This identification suggests the increased usage of past performance as an award criterion, a legitimate technique to indicate the rewards for those defense contractors who perform well. In making closer inter-organizational ties, the government must also tailor appropriate contracts to the extent possible with appropriate profit targets.

Although this approach is consistent with study findings, high-level government objectives to increase competition and maximize the obligation of contract dollars will make it a difficult one to pursue. The government should be aware that these objectives, if not thoughtfully planned for, can work against the objective of contractor motivation by fostering hurried, impersonal, and discontinuous contractual relationships. Inadequate procurement resources also jeopardize the ability to foster positive relationships.

Buyers should take advantage of the relationships shown in Tables I-IV to tailor individual motivation strategies. Full-blown strategies can be developed from Table IV if the objectives of the leading contractor are known. Buyers should look for the most useful motivation distinctions among contractors on the basis of capital (vs. labor) intensity, percentage of government business (at the division level), and ownership (public vs. private).

Marketers for firms doing business with DOD must become aware of their firms' individual *contractual* objectives as well as overall corporate objectives, and the potential for match-up with the government's objectives on a given purchase. They must become conscious of what the firm as an entity will respond to and the perception the government has of what the firm will respond to. In other words, those who could sell to DOD (and the rest of the federal government) must communicate to the government buyer how they can best exchange behaviors to mutually satisfy contractual objectives.

More specific buying research is needed on: (1) Unconventional incentives not contemplated in this article, particularly those incentives now pro-

NO OTHER STUDY RESULTS PRESENTED BY SURVEY

| | GOOD PRODUCT | SURVIVAL | GROWTH | PROFIT | ROI | IMAGE | SKILLS | USE EXCESS CAPACITY | CONTINUING RELATIONSHIP | NEW CAPABILITY | DOMINANT POSITION | CASH FLOW |
|---|--------------|----------|--------|--------|-------|-------|--------|---------------------|-------------------------|----------------|-------------------|-----------|
| HIGH PROFIT | | | | .473 | .452 | | | | | | | |
| AWARD FEES | | | | | | | | | | | | |
| INCENTIVE FEES | | | | .296 | *.283 | | | | | | | |
| MULT. INCENTIVE FEES | | | | | .312 | | | | | | | *.278 |
| CASH FLOW | *.272 | | | | *.261 | .364 | .343 | | | .309 | | *.515 |
| CONTINUITY | .325 | | | | | *.265 | .389 | | .375 | .331 | | |
| FUTURE BUSINESS | | | | | .297 | | .309 | | .405 | .380 | | |
| LONG-TERM FUNDED CONT. | | | | | *.250 | | | .308 | | | | |
| PAST PERFORMANCE | | | | | .310 | .289 | *.242 | | .400 | | | |
| CAP. INVEST. PROTECTION | | | .387 | .417 | .551 | .291 | .336 | | | | | |
| NON-MONETARY AWARDS | | | | | | .312 | | | | | | |
| GOVERNMENT-FURNISHED CAPITAL INVESTMENT | | | | | | | | | | | | |
| COMPETITION | | | | | | | | | *.249 | | | |
| DENY FUTURE BUSINESS | | | | | | | | | | | | |
| LOSS FOR POOR PERFORMANCE | | | | | | | | | | | | |
| TERMINATION FOR DEFAULT | | | | | .315 | | | | .344 | | | |
| PERFORMANCE BONDS | | | | | | | | | | | | |
| THREAT OF COMPETITION | | | | | | | | | | | | |
| GOOD RELATIONSHIP | .316 | | | | | .491 | .360 | | .379 | | | |
| APPRO. CONTRACT TYPE | | | | | .370 | .308 | | | *.251 | | | |
| FAIR/EQUITABLE CONTRACT | | | | | | .304 | .340 | | *.272 | | | |
| JAWBONING | | | .298 | | *.249 | .262 | | .244 | | | .287 | *.282 |

P < .0025 (No *)

P < .01 (*)

**Incentive 15 left off Government Questionnaire

THE EFFECT OF CONTRACT TYPE ON CONTRACTOR PERCEPTIONS AND BUSINESS RESULTS CONTRACTOR PERCEPTIONS

| | GOOD PRODUCT | SURVIVAL | GROWTH | PROFIT | ROI | IMAGE | SKILLS | USE EXCESS CAPACITY | CONTINUING RELATIONSHIP | NEW CAPABILITY | DOMINANT POSITION | CASH FLOW |
|---|--------------|----------|--------|--------|-------|-------|--------|---------------------|-------------------------|----------------|-------------------|-----------|
| HIGH PROFIT | | | | *.299 | | | | | | | | |
| AWARD FEES | | | | | | | | | | | | |
| INCENTIVE FEES | | | | | | | | | | *.323 | | |
| MULT. INCENTIVE FEES | | | | | | | | | | | | |
| CASH FLOW | | .464 | | .514 | *.303 | | | | | | | .518 |
| CONTINUITY | | *.319 | *.322 | | | *.314 | | *.298 | | .407 | | |
| FUTURE BUSINESS | | | .365 | | | | | | | *.294 | .360 | |
| LONG-TERM FUNDED CONT. | | | | | | | | | | | | |
| PAST PERFORMANCE | .352 | *.307 | | | | | | .473 | .369 | .460 | | |
| CAP. INVEST. PROTECTION | .422 | *.336 | .383 | | .442 | .437 | | .386 | .437 | .411 | | .457 |
| NON-MONETARY AWARDS | .348 | | | | | .355 | | .358 | | *.329 | | |
| GOVERNMENT-FURNISHED CAPITAL INVESTMENT | | | | | | | | | | | | |
| COMPETITION | *.302 | | | | | .385 | | *.333 | .376 | .447 | | |
| DENY FUTURE BUSINESS | .481 | .542 | .345 | .348 | *.298 | .421 | .369 | *.296 | | .431 | | .398 |
| LOSS FOR POOR PERFORMANCE | | .257 | .377 | .344 | | | | | | | | |
| TERMINATION FOR DEFAULT | | .344 | | | | | | .419 | | | | |
| PERFORMANCE BONDS | | .332 | | | | | | .415 | | | | |
| THREAT OF COMPETITION | | | | | | | | | .377 | | | |
| GOOD RELATIONSHIP | .358 | | | | | .432 | | | .383 | .634 | | |
| APPRO. CONTRACT TYPE | | | | | | | | | .452 | *.307 | | *.300 |
| FAIR/EQUITABLE CONTRACT | | | | | | | | .357 | .526 | *.328 | | |
| JAWBONING | | | | | | | | | | | .392 | |

P < .0025 (No *)

P < .01 (*)

hibited by regulation and statute (there is evidence that tax arrangements, use of surplus government materiel, government management assistance, and other such opportunities for contractual exchange could be effective in enhancing contractual performance); (2) the increased use of performance bonds and monetary loss for poor performance as incentives (the study results were ambiguous on these topics); (3) flowing down incentives to workers on the defense production line (current incentives appeal primarily to executives, e.g., profit); and (4) evaluation of the relieving of constraints on the use of various incentives. ■

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PMC Graduates Among Four Receiving SECDEF Superior Management Award

An Army colonel and a Navy captain, both graduates of DSMC's Program Management Course, and two Air Force program management teams are recipients of the 1982 Secretary of Defense Superior Management Award.

Colonel Ronald K. Andreson, USA, a graduate of PMC 73-1, and Captain Robert M. Wellborn, Jr., USN, a graduate of PMC 76-2, along with the Air Force recipients, were presented the awards by then Deputy Secretary of Defense Frank C. Carlucci on December 29.

First presented in mid-1982, the Secretary of Defense Superior Management Award is designed to recognize superior management involving implementation of the Defense Acquisition Improvement Program initiatives. It is presented to individual program managers and program management teams in each of the services. Winners are judged by criteria that include exceptional management of a logistics/acquisition program for one year; success in pursuit of their mission in association with industries, the public, and government agencies; and development of a system or idea that results in monetary savings or more effective support for operational forces.

Colonel Andreson is Project Manager for the Army's UH-60 Black Hawk Helicopter program. He was cited for his "superb analytical and decision-making skills which enabled him to

maximize commonality and to reduce costs among the UH-60 systems." Andreson successfully implemented six of the Acquisition Improvement Program initiatives. Of particular note among Colonel Andreson's achievements is work in the multiyear procurement area that has resulted in a potential savings of \$82 million.

Captain Wellborn is Project Manager for the Navy's Advanced Lightweight Torpedo Program. Wellborn is credited with restructuring a troubled program to follow principles outlined in a number of the Acquisition Improvement Program initiatives and turning it into a "showcase" program. (The Advanced Lightweight Torpedo Program is one of three Navy programs selected for participation in the Department of Defense demonstration project reflecting the three AIP initiatives dealing with systems support and readiness, contractor incentives to improve reliability and support, and improved reliability and support for expedited programs.)

Chief Master Sergeant Douglas C. Tutchter of the Warner Robins Air Logistics Center and the program management team managing the AN/USM-464 Countermeasures Test Set (CTS) are winners from the Air Force Logistics Command. The CTS is an urgently required test station that stimulates electronic warfare threats and tests the operational capabilities of the

aircraft's countermeasures systems. Innovative management strategy is allowing this system to be fielded this year instead of 1985, as originally planned. The CTS team has managed this \$300 million program in a "superior manner, without a single schedule delay."

The Air Force Systems Command's Defense Satellite Communications Systems Program Office was the other Air Force awardee. The citation read in part: "During this period, multiyear procurement plans were developed and approved for the procurement of seven satellites with estimated savings of over \$55 million. The program has successfully applied the economic buy quantity concept to advance buy parts procurement for which a \$36.8 million Value Engineering Award was earned in fiscal year 1982. Productivity and learning curve analyses were used effectively in negotiating the first four DSCS III production satellites, resulting in a savings of over \$31.2 million. Through the use of a careful blend of profit, cost and performance incentives, award fees, and other provisions, contractor attention to reliability and readiness has been insured. Additionally, the first DSCS III satellite was placed into geosynchronous orbit on 30 October 1982 together with a DSCS II in an unprecedented combination of four "firsts." ■

The Program Management Office—

WHO'S REALLY RUNNING THE SHOW?

Major Hayward P. Ladner, USAF



Program management is defined in the context of DOD Directive 5000.1 as a concept for the technical and business management of a complex weapons system acquisition. The directive has also provided the following major tenets: (1) a single responsible manager; (2) responsibility and authority vested in the program manager; (3) minimum layers of authority between the program manager and his component head; and (4) tenure of the program manager long enough to be effective. That single individual will be given responsibility for the management of a program throughout its acquisition. This individual, the program manager, has total responsibility and authority over all technical and business aspects of the program. The program manager must ensure that his program is properly funded, planned in detail, technically achievable, and completed on schedule, and that it satisfies an established military need. In this process, he must deal with many diverse organizations. He manages people assigned directly to his program office, coordinates with functional organizations supporting his program, satisfies reporting requirements up his chain of command,

Author's Note: I want to express my thanks to those program managers and deputy program managers whose candid remarks made this paper possible.

Program Manager

and interfaces with other military services when required. His most important task is making sure that the program objectives in the terms of cost, schedule, and technical requirements are accomplished by his contractors or by in-house agencies.

The essence of the program manager's role is to be the agent of the service in the management of the systems acquisition process to focus the authority and responsibility of the service for running the program. He must be the major force for propelling the system through its evolution. An analogy of the role of the program manager would be to that of the general manager of a company. The general manager is whatever is needed to move the affairs of the business. He does one thing at a time and another thing at another time; whatever is most needed at the moment to achieve his objectives. However, a general manager is not a routine doer of any particular job. There are other managers charged with the doing. But the general manager sees to it that what he wants is done and what he wants is a harmony of things done so that his objectives are achieved. The role implies reliance on others to do the work, but it also implies controlling and coordinating the work so that no one aspect dominates others to the detriment of the whole.

Another role the PM must assume, though controversial, is the role of advocate or the marketer for his program. As one program manager put it, "The program manager's main job is to make the program look good. I don't mean fake it. I mean to be on top of the program, to anticipate what the boss expects, what the budget people expect, what OSD expects, and even what Congress expects." The image of an energetic, and capably managed program is a great asset in recruiting the right people for the program office and in obtaining the right kind of support from functional organizations. The morale and success of the program office staff are largely a reflection of that image. A good image results in cooperation, and a poor image results in constant struggling to get what is needed. If the program manager does not do his job well, not only in managing it but in "selling" it, he may lose his job. Worse yet, a needed program may be eliminated because of adverse publicity or a lack of strong support.

Another role the program manager must assume is the direct interface with the customer, the user. The user may

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not be the direct source of the system requirements, and may be represented by a requirements activity. In that event, the program manager has two customers and a more complex problem of coordination. The whole purpose of weapons systems development is to satisfy the user's need. The program manager has to face the fact that he may have an unhappy customer from the beginning. Moreover, the customer will become even more unhappy when the problems that inevitably arise during development force him to retreat further from the system capability he wants. Trade-offs will have to be made throughout the development process. Since the user is a customer, he must participate in the trade-off decisions. If the program manager attempts to make the decisions unilaterally for the customer, he is courting disaster. When the program manager is required to interface directly with the user, this is definitely a time pull for the program manager.

Many of the activities of the program manager take him away from the office on temporary duty (TDY). In fact, a 1974 study of the way one program manager spent his duty time revealed that 60 to 70 percent of that time was spent on TDY. This is not an exceptional case. Many program managers spend more than half their time dealing with people and agencies outside the program office. Yet, they also are responsible for the day-to-day operation of the office. How can the PM run his office when he spends almost half his time away from it? One answer may be found in the second in command—the deputy program manager. As one program manager stated:

During the last year I was TDY 136 days out of approximately 220 work days. Now, you know the program office could not have functioned had I not had a super deputy. He ran the program as much, on a time basis, as I did. So, I really think the deputy is a surrogate in terms of a replacement or stand-in for the program manager.

This paper looks briefly at the roles, responsibilities, and importance of the deputy program manager. In preparation of the paper, about 20 PMs and deputy PMs were interviewed. Their responses give some insight into the real as well as the perceived roles of the deputy program manager.

Corporate Memory

The Army and Navy have established almost all their deputy PM positions as civilian. The Air Force, although it has maintained a mix of both military and civilian deputies and in some major programs has established dual-deputy positions—one civilian and one military—the move in the Air Force tends to be toward the employment of a larger percentage of civilian deputies.

Usually, the deputy has more longevity on a program than the program manager, especially if he is a civilian. Then, they can be a valuable corporate memory resource. The following sentiments reflect the opinion of several of the PMs interviewed:

I like civilian deputies because they have usually been in the command for a number of years and probably have been on a certain program through several program managers. Corporate memory and continuity are of prime importance when a new program manager is assigned. The deputy can provide for a smooth transition. Since he normally has command longevity,

he generally knows the command structure and has established working relationships with critical functional organizations.

Corporate Style

One civilian deputy program manager felt he offered more than corporate memory. He stated:

I have been a deputy to six program managers prior to this assignment. I have only been here 1 year, and I don't know nearly as much about this airplane system as the boss. I probably won't know as much as his eventual replacement, but I do know how program managers succeed and fail. It's very likely that his replacement will come from an operational unit and be inexperienced in being a program manager. I think I can help him adopt styles and techniques that other project managers have used with success. My last boss was a super salesman, and he had phenomenal marketing techniques. I introduced a lot of them to my present boss. He has improved his marketing style as a consequence of the many things I've exposed him to. Some of them he liked; most of them just didn't suit his style, so he discarded them. We just had a big presentation and I could see some of my old boss' style in his style, which was radically different from his last briefing.

Business Manager

With the program manager being TDY much of the time, the deputy must assume the majority of business management of the program management office. The following is one deputy's view of the business manager's role.

The project manager does tend to be a Mr. Outside; he's interfacing with the generals and admirals and, to a large degree, with congressmen, senators, and their staffs, whereas the deputy project manager, at least in this office, does tend to be a Mr. Inside, interfacing with the people within the command—primarily interfacing with people at the prime contractor's or subcontractor's facilities on business matters. The deputy project manager is really the business manager. Chances are he'll be here longer; most deputy project managers will be there longer than the project manager, so they tend to have the historical background or the business historical background of the project.

Another deputy had this view of the deputy's role as the business manager.

Most of the people, to my knowledge, who become deputy project managers are technical types. Inherently, they are interested in solving the technical and financial problems, because they go hand in hand. However, when you get to the deputy level, from our experience in this command, you wind up managing the internal workings of a program office, directing and coordinating all the personnel actions, which is the least satisfying, I think, to the guy who has a strong technical background. I think there must be a way to give more opportunity for the deputy to become involved with the decision process on the technical side. And that becomes a sore point. I think in a lot of cases the PMs are too prone to shove all the ad-

ministrative responsibilities on the deputy and keep all of the activities that require technical inputs and that require presentations, almost what you might call PR work, to themselves. In the long run, if the split is defined that the deputy doesn't get involved in technical activities and decisions because he's overloaded with administrative details, the program will lose something in continuity.

Another deputy echoed these sentiments:

The project manager has a real problem. The deputy is highly capable and probably could do the job, given the right set of circumstances, as well as the PM. Yet, the PM has areas that he can't get involved in that are extremely important, and he also recognizes that he has limited resources. For example, why have both the PM and the deputy gone to meetings, or both gone to presentations, when the PM can split the activity and have the deputy concentrate on some of these other areas while the PM concentrates on the ones that are PR. The PM makes the decision to give the deputy things that are important but are not things that probably would enhance the PM's career.

Qualifications and Training

During the interviews, the opinions of the program managers and deputies were much the same on the qualifications and training. They agreed that the deputy should be technically oriented but very strong in management. The training for deputies ranges from short acquisition courses to 1-year programs at Harvard.

One deputy PM stated:

The deputy must have a technical background in order to be able to make decisions that are in the best interests of a project, particularly when responding to the requirements of the project in the absence of the project manager. There's no question about that. He has to have a good background in management, and that is something that is going to have to be taught over the years and with particular training. I think anybody who's slated to be a deputy in a project management office should, at some point in his career, be sent out for advanced training, and I'm not talking about short courses. I'm talking about a course—at least a year long and at some of the good schools, MIT, or Harvard, or Wharton School of Business—or one of those courses that would allow him to get a broad background in management that ties the requirements for running a project to requirements for running the personnel side of the house and the requirements for integrating all that with the financial responsibilities. I think he also should be a resident at a plant operation for at least a year.

Compatibility

Whenever a program office is being staffed, or when either the deputy or the program manager is being selected, compatibility between the PM and the deputy should be a prime consideration. One deputy stated it quite simply.

I truly believe that every "merger" of bringing a military program manager and a civilian deputy together should be done to ensure compatibility. Because if the

team is compatible, the program will succeed, but if the team is not compatible, the program will be doomed over time.

Conclusions

The deputy program manager—Mr. Inside—is probably the most misunderstood individual in the program office. In many ways, being a deputy is a lot tougher than being a PM, because the deputy has to support the PM's policies, and frequently on hot programs with the PM gone much of the time the deputy must really walk a tightrope between what he thinks should be done on the program and what is being committed by the program manager during the various meetings while on TDY. By the very nature of the job, the deputy program manager can't always attend all of the discussion that drives the PM. Increasingly though, particularly on big programs, the position of the deputy has become far more important because the new challenge for the deputy seems to be that he has to not only run the internal program, but that he frequently has to go out and extinguish fires, especially with contractors. Also, because of the demands of the program manager's briefing schedule, he frequently has to present high-level briefings himself. So the deputy has all the challenges of a program manager—without the visibility.

The most important task for the deputy program manager is the management of human resources within the program management office. The program management office personnel are the medium for getting work accomplished. If people are to function at peak efficiency, they must be fine-tuned. The deputy program manager should know the fine-tuning procedures for his people. In addition, the deputy program manager must accomplish program objectives through the project team. This requires a knowledge of each individual within the office. His subordinates must feel that the deputy has confidence in their judgment. Therefore, he must be equipped to judiciously select and skillfully apply the tools of management. The deputy program manager is constantly involved in organizing, planning, controlling, coordinating, and leading. These elements are all inter-related and must be evaluated in terms of total organization objectives. The deputy communicates leadership by maintaining a balance between individual motivation and project-office efficiency. The deputy program manager has to have not only knowledge, but decision-making and social sensitivity. These elements are mandatory for effective management by the deputy program manager. Knowledge is a prime input in the deputy program manager's decision-making process. He must have a clear understanding of management principles. In addition, he must also comprehend the weapon systems acquisition process.

The deputy program manager should not necessarily be strong technically. The deputy has to complement the personality and the skills of the program manager. The job of program manager is big enough that no one person can really capture all of the skills necessary to do the job totally alone. So the deputy selection should be based first on whether or not the deputy's experience complements that of the program manager and the other key members of the team. The deputy should have all of the skills of the program manager. The deputy should be looked upon as the person whose opportunity to manage a major program hasn't come up yet. ■

The International Financial Structure and Its Impact on the Program Manager

Major (P) T. E. Peoples, USA

The health of the international financial structure is the subject of a great deal of contemporary debate. To many, its relative condition in today's world is likened to that of the Ottoman Empire in its region prior to the outbreak of World War I—the sick man of Europe. Others see the current wave of rescheduling (see glossary) based on individual national liquidity as a routine or, at worst, a bump in the path resulting from temporarily escalated interest rates.

Commentary on today's conditions comes from all sectors: participants, analysts, and government officials. Walter Wriston, Chairman of Citicorp, claims to be unconcerned; he maintains that fears for the structure are not warranted, because sovereign nations don't go broke.¹ Senator Henry Jackson has called on the United States and other major powers to take concerted action to restore confidence in "the credit worthiness of banks."² Bank analyst George Salem of Bache & Company is amazed that bank stocks are experiencing a spectacular resurgence in the midst of an international banking crisis that two months ago had analysts in government compiling lists of banks that might not survive.³ Irwin L. Kellner, Senior Vice President and Economist at Manufacturers Hanover Trust, lays blame for the rumors at the door of the financial press. His position is that through printing the hearsay it becomes self-fulfilling prophecy.⁴

In the view of the Department of Defense program manager, is this claimed fragility of the international financial structure, this liquidity crisis, a cause for concern over future problems in major weapon system acquisition programs? In order to arrive at a position on this issue, one must ask three additional questions.

—What is the cause of the current financial situation and its attendant debate?

—Are international banking and western governments justly criticized regarding extension of credit to lesser-developed countries (LDC) and the Communist Economic Consortium (COM-ECON) members with inadequate risk analysis (or none at all)?

—What program impacts could result from creditor nation defaults and/or international lending institution failure?

The Causes

The causes of the current international financial situation can be found in two areas. The first, and without question the principal cause, was the separation of oil from the general grouping of commodities in 1973 and its subsequent massive rise in price. The lesser-developed nations simply could not continue domestic programs and acquire essential energy with internally generated economic surplus. They were forced to expand the use of credits to cover all requirements. The second cause, massive LDC industrialization and COMECON reindustrialization as a subset of detente, placed the western world in the position of having to finance industrial and high-tech sales to those nations in order to ensure international market share. As a result, net liabilities, in current dollars, to western banks for COMECON rose from \$9 billion in 1973 to \$80 billion at the beginning of 1981.⁵ Among non-oil-producing LDCs a total of \$600 billion is owed, 60 percent to commercial banks. Latin America alone accounts for \$250 billion. Mexico, though an oil producer, is counted in at \$80 billion, Brazil at \$40 billion, and Argentina at \$37 billion.⁶

Nine major U.S. banks (Bank of America, Chase Manhattan, Citicorp, Manufacturers Hanover, Bankers Trust, Chemical, First Chicago, Continental Illinois, and Morgan Guarantee) currently have \$62 billion outstanding in loans to COMECON and lesser-developed countries. That figure represents 240 percent of total bank capital. Internationally, \$300 billion of the \$600 billion outstanding is due in the next 3 years. For the nine American banks, loan service receipts next year represent 150 percent of total profits for 1981.⁷ Estimates today indicate that 90 percent of current borrowings are being used to service old debts.⁸

The U.S. Government is not escaping the general exposure problem suffered by the commercial banks. Like many other governments, it must guarantee loans for the purchase of U.S.-made military hardware. The General Accounting Office (GAO) reports Department of Defense guaranteed credits from the U.S. Treasury (primarily through the Federal Financing Bank), which customer nations have used to finance hardware purchases, will probably be

\$18.9 billion by the end of FY 1983. As of February 1982, 13 customer nations were technically in default: Bolivia, Nicaragua, Ethiopia, Costa Rica, El Salvador, Liberia, Senegal, Tunisia, Zaire, Lebanon, Morocco, Sudan, and Turkey. The programs they bought under had 30-year terms, but included a 10-year grace period in which only interest was due. To illustrate the difficulty debt service alone can create for an LDC, one has only to look at Israel and Egypt. Egypt will be paying \$1.2 billion in total annual interest by 1989. Israel is not far behind, with total current interest payments of \$910 million annually. None of the customer countries is an industrial power, let alone a net exporter.⁹

As of February 1982, 13 customer nations were technically in default.

The COMECON situation is particularly dangerous. Near default in Poland and Rumania has dammed the flow of western credits to COMECON. As stated previously, \$80 billion remains outstanding. Trade with the Eastern Bloc, excepting Russia and Bulgaria, is on a cash or cash cover (in buyer bank) basis. Russia has been able to sustain 45-day cash terms. Tiny Bulgaria is the only Eastern Bloc nation with a decent credit rating. Proof of cash deposits in her internal accounts is not required for external purchase. Barter has become the prime means of trade. Cash payments are made for goods, but they are turned over in hours or, at most, days through intricate exchanges of goods. Barter cartels in London, Munich, and Lausanne are thriving on Eastern Bloc business.

Payments being made on Eastern Bloc debt service appear to be flowing as a result of massive Russian sales on the gold market, her only source of hard currency.¹⁰ The other members of

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COMECON (less Bulgaria) show negative net trade balances and are unable to cover debt service.

The Positions

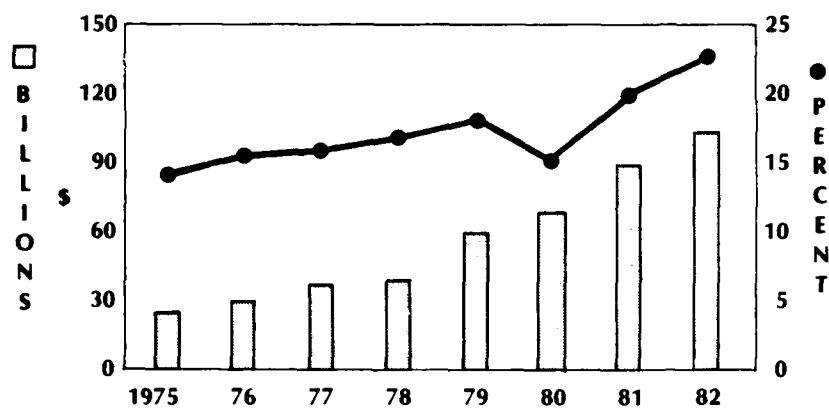
Bank and government officials, while aware of the serious nature of the financial squeeze on the international market, point to two solutions and profess total confidence in both. The first is the Basel Pact.

The Basel Pact dates to 1974 and is a private accord, the details of which never have been made public. What is public is the general guideline that the industrial world's central banks, the Federal Reserve, the Bundesbank, and the Bank of England will intervene if a bank from their countries should show signs of failure.¹¹ They will step in and act as the lender of last resort. The theory is good. Its intent is to provide confidence in the structure, but in practice it leaves much to be desired. There are over 15,000 banks playing in the international market. Many are owned in one country, exist in another, and do business in still others. The problem develops when (1) the country of ownership has no central bank, or (2) the central bank refuses "coverage because business is conducted solely off shore."¹² Still more difficulty ensues after the central banks solve an initial cash-flow problem such as that which developed recently as a result of Mexico's illiquidity. Mexico avoided default and the banks were saved, but then Mexico, or any LDC involved, is faced with doing business with the International Monetary Fund (IMF). The fund will provide credits and deposits, but in return demands that the country get its financial house in order.¹³ The requirements are usually stringent economic policy implementation, a difficult pill to swallow after a decade of unstructured credit spending.

The second solution to national illiquidity, a convenient avoidance of the word default, is to reschedule the debt. Formal default must be avoided at all cost. For a nation to default would mean exclusion from the marketplace for a lengthy period. The creditor commercial banks would fail, and the structure would collapse for lack of confidence. Rescheduling avoids these disagreeable outcomes. It also supports the thesis that sovereign nations don't go bankrupt.¹⁴

Simply put, when a nation is in default the banks in jeopardy simply

DEVELOPING COUNTRY DEBT SERVICE GROWTH



renegotiate the loan terms. The result is a good loan on the bank books vice a write-off, and at least some cash flow where there was none before. The bank stays in business and the country can usually negotiate from strength for reduced rates due owing to its *de facto* control of the bank's exposure. Mexico, with \$80 billion in debt, did precisely that.

Rescheduling is on the upsurge. The Overseas Development Council studied the problem and maintains that in the period 1975 to 1981, 25 reschedulings for 14 LDCs took place as opposed to 30 for 11 countries in the 18 years prior. Total arrearage rose from \$500 million to \$5.5 billion during the later time period.¹⁵

Rescheduling can be called credit program stretch out. The banks see it as a means of corporate survival. The LDCs, faced with ballooning debt service growth, consider it a natural event in the business cycle.¹⁶

Rescheduling has other costs in addition to late and reduced bank profits. The banks and governments have at last been forced to begin risk analysis of borrowing nations. The results have been as many had predicted. The *Economist* estimates that 45 percent of exports to COMECON this year are under producer government guarantee. The LDCs are being frozen out.¹⁷

The Impacts

In reviewing what has been presented thus far, the impact of a weakened international financial structure on the DOD program manager begins to come into view. If a major collapse of confidence in the international financial structure should occur, the

program manager of a major system would be faced with immediate program instability.

Foreign military sales generated from industrial nations as well as LDCs would certainly be truncated, if not canceled outright. Congress, given its current political composition, might feel compelled to withdraw further loan guarantee/extension authority. Commercial off-shore sales by program contractors would certainly suffer with a resultant increase in overhead and direct labor rates following a business base reduction and lay-offs of junior employees. Planned research, development, test, and evaluation cost recovery from FMS sales would not be forthcoming. Interest rates, if borrowing were to continue, would rise dramatically causing the low margin contractor to move into a net loss position.

The program manager, whether in development or production, whether he's holding a fixed-price or cost contract, would be forced by circumstances to prepare for renegotiation of his outstanding contracts. Many multinational programs currently have provisions in contracts that require new negotiations in these circumstances, e.g., AWACS.

Program funding would take on even greater importance. Cost increases, under no one's control, would have to be reflected in a revised Five Year Defense Plan. Costs of an immediate nature would have to be covered by reprogramming and supplemental appropriations.

Congress would be faced with a prioritization of programs in the defense arena in juxtaposition with domestic

program actions of overriding concern. The Department of Defense would no doubt prioritize in the program objective memorandum (POM), but issues of this magnitude ultimately are decided in the political forum. Program stretch-out, authorized acquisition objective reduction, or termination would be the only probable alternatives for all but the most important systems.

In summary, it would appear fair to say that the existing exposure of commercial banks and industrial governments in the international financial market is of crucial concern to DOD program managers. International funding data is readily available in-house and in the financial press. Publications such as the *Survey of Current Business*, published monthly by the Department of Commerce; *The International Financial Statistics Monthly and Annual*, from the I.M.F.; and *The World Bank Statistical Year Book* are prime sources. Dailies and periodicals are worthwhile as well; *The New York Times*, *The Washington Post*, *The Economist*, *The Wall Street Journal*, *The International Herald Tribune*, and journals such as *The American Economic Review* all provide excellent background and up-to-date fund data.

Prudent observation of overall trends and tracking of customer nation financial position would pay off handsomely for a PM. He could either avoid business with high-risk countries that lack strong political backing, or ensure that decision- and policy-makers in DOD and members of the Congress are

GLOSSARY OF TERMS

COMECON. Communist Economic Consortium; consists of USSR, Poland, Hungary, Czechoslovakia, Rumania, Bulgaria, East Germany.

Rescheduling. Renegotiating the conditions of repayment of a loan; can include amounts and/or time frame.

LDC. Lesser Developed Countries; the majority of the Third World. Includes most nations in South America, Africa, Asia, and a vast majority of the world's island states.

Industrial Power. A country that possesses an efficient industrial infrastructure, and is using it.

Net Exporter. A nation with a positive international trade balance.

well aware of potential program impacts should a nation default that has strong political support but is exhibiting weak financial position.

Preliminary analysis of impact, given available business base data on the program prime contractor and his suppliers and subcontractors, would be relatively simple. Sources include corporate annual reports, *Standard & Poor's Stock Report*, *Moody's Industrial Manual* (annual), *Wall Street Transcripts*, *Aerospace Facts & Figures* (annual), and the FINANDAS Data Bank, which can be accessed using the Air Force Systems Command's Copper Impact System.

Anticipation of problems through research and analysis could well mean survival, rather than termination, during financial crisis for a program critical to national defense. ■

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FEEDBACK

Dear Sir:

With regard to Louise Becker's article ["Military Computers in Transition: Standards and Strategy"] in the Autumn 1982 issue of *Concepts*, she includes in her definition of interoperability the interchangeability of parts. The approved definition of interoperability relating to computers and automatic data processing deals with the ability of computers to communicate meaningfully with one another. She should make reference to Federal Standard 1037, or to the second definition in *Joint Chiefs of Staff Publication 1* (which follows): "The condition achieved among communications electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases."

Some further definition may be required to permit the development of a standard for interoperability. While there is no consensus on the further delineation of a definition, I have several observations on the components of interoperability which may aid in understanding it.

The first component of interoperability is compatibility, which describes the ability of two systems and/or equipment to communicate. It includes the message formats, the coding scheme of messages, the communication protocols used, and the actual electrical interfaces. This component consists of qualities which are binary in nature. Compatibility either exists or it doesn't. Messages either mean the same thing to the sender and receiver or they don't. The act of communications requires a communications channel which leads to the next component.

The second component relates to the transmission times for messages through whatever medium/media might be used, and the utilization of the available bandwidth in these various media. This second component involves the encoding efficiency of the information being transferred, the encoding redundancy with regard to error correction/detection, the command/control codes incorporated in the

message stream to utilize the medium/media, the effects of the scrambling devices (if used) and the resultant error rate available to the communications-electronics system using the channel. This component involves information theory for its evaluation.

Finally, Mr. Grady Banister (Technical Director, U.S. Army Electronic Proving Ground) suggests that the third component relates the use made of the transmitted information and the utility of the transmitted information to the accomplishment of the mission of the two communications-electronics systems interchanging data. This component requires the investigation of operational effectiveness for its evaluation.

An enormous amount of work in the message compatibility field was called interoperability, but this work has not covered the complete field. This brief description does not encompass the total field of interoperability, but it does provide a foundation on which to base a more detailed understanding.

John W. Shaver
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Don't Forget the DSS Survey

The November-December 1982 *Program Manager* included a DSMC/AIRMICS decision support systems (DSS) survey. The text accompanying the survey discussed a possible DSS conference to be held in Washington, D.C., in the fall of 1983 and asked readers interested in such a conference and in improving methods of exchanging information on DSS to complete the survey and return it to DSMC. Readers who are interested but have not returned the survey are urged to do so as soon as possible. ■

AIP ACTION 6: Budget to Most Likely Cost

Major Gary J. Jungwirth, USAF

AS I SEE IT

PRICE
2.5K
3.6K
6.8K
INQUIRE

Action 6 of the Acquisition Improvement Program, Budget to Most Likely Cost, must be viewed with the other 31 improvement actions if we are to understand its significance and implementation. It does not stand alone as a solution in itself, but says something about how we, the acquisition community, should do business under many of the improvement actions. As I interpret the initiatives, there are two major goals of the Acquisition Improvement Program (AIP): improve efficiency, and improve realism. Action 6 is clearly aimed at the latter goal. It says we need to be more realistic—we are too optimistic. In fact, we are intentionally optimistic.

The philosophy of realism represented by the initiative to Budget to Most Likely Cost is also reflected in a number of the other AIP actions.

A quick review of these initiatives will demonstrate the realism theme and some actions necessary to achieve it:

1. *Management Principles*—improved long-range planning and realistic budgeting and full funding.

4. *Increased Program Stability in the Acquisition Process*—fully funding R&D and procurement.

8. *Assure Appropriate Contract Type*—realistic assessment of contractor and government risk.

11. *Incorporate the Use of Budgeted Funds for Technological Risk*—deal with uncertainty.

12. *Provide Adequate Front-End Funding for Test Hardware*.

18. *Budgeting Weapon Systems for Inflation*—to more realistically portray program cost.

19. *Forecasting of Business Base Condition at Major Defense Plants*.

20. *Improve the Source Selection Process*—added emphasis on schedule realism, cost credibility.

22. *Provide More Appropriate Design to Cost Goals*—to provide effective incentives.

Clearly, the synergistic effect of these initiatives will go a long way toward achieving realism. The importance of realism is that it will lead to program stability, and in turn lead to improved efficiency and lower costs.

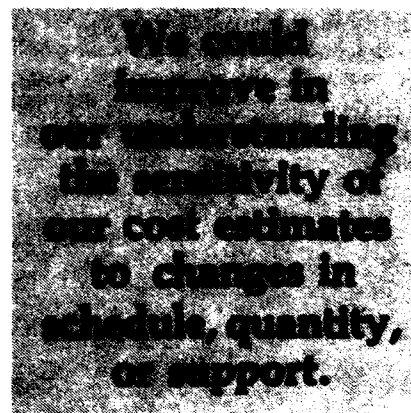
Combating Optimism

To implement Action 6, we must address two problems—real optimism and intentional buying-in. Studies on cost growth show the following causes: economic inflation, quantity changes, estimating changes, schedule changes, support changes, engineering changes, and other changes. Optimism may influence any or all inputs needed to produce a cost estimate and will contribute to the cost growth registered in each of these cause categories. For Action 6 to be fully implemented, acquisition managers at all levels must realize that beyond cost, we may be optimistic on

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Program Manager

performance, schedule, quantity, production rate, facilitization, inflation, or risk. The secret to developing the realistic cost estimate is in accurately determining the inputs. As expressed in the world of computers, with garbage in, you will get garbage out. This may be an obvious point, but it is often overlooked in addressing most likely cost. On the other hand, intentional optimism, known as "buying-in," is an attempt to game the acquisition process—get a foot in the door during development and make up the difference later in production. The most



likely cost estimate is tempered by management judgment as to "what will sell" or "what will win." These adjusted cost estimates are seen in both contractor's proposals and in DOD budgets. What can be done to manage optimism and buying-in problems that are basically judgmental and political?

Many things are being done. All of the initiatives reviewed at the beginning will help in budgeting to most likely cost. What follows is an evaluation of what is being done in selected areas and my suggestions for further action. We will first look at what can be done to manage the problems from within DOD and then what can be done to control contractor contribution to the problems.

Planning for the Unplanned

The first thing that must be done is to recognize the problem and plan for it. Planned management reserves and budgeting for risks are, in effect, an insurance policy that anticipates an overrun and provides resources to handle it. I think Action 15, Funding Flexibility, is another attempt to manage an overrun with minimum disruption to the program affected, or to other programs. The reserve strategy is a good

one and has long been used in industry. One area we could improve is in understanding the sensitivity of our cost estimates to changes in schedule, quantity, or support. When we find high sensitivity we should at least be alert to it and, if possible, plan a more conservative approach. The draft of DODI 5000.2 (April 9, 1982) has some thinking along these lines, but I think it should go farther by requiring (1) that the sources of the point estimate uncertainties be identified, and (2) that strategies be developed to handle them.

Rewarding Realism

Another effort that is now under way is intended to instill the Budget to Most Likely Cost philosophy into the DOD acquisition community. The first step of education and policy publication is continuing. Even more important is the process of developing people's perceptions of upper management's seriousness in supporting this initiative. These perceptions will be influenced by how DOD leaders and the Congress react to the realistic or unrealistic estimates provided by the services. Will realistic estimates and programs be supported, or will programs be killed in favor of other programs attempting to buy-in? Universal acceptance of the philosophy of realism can only be achieved by consistent support of the leadership.

Independent Cost Estimates

Other actions being taken are aimed at discovering and avoiding optimistic cost estimates. This is being done through the vehicle of independent cost estimates. A new policy (DepSecDef Memorandum dated May 19, 1982) requires that selected programs use independent cost estimates (ICEs) in addition to the PM's cost estimate in developing the program budget. The higher of the two estimates is to be used in the budget submission unless sufficient rationale can be provided for using the lower. Letting a non-advocate third party assess the program cost can keep optimism out of the cost estimate, but only if the ICE is based on an independent assessment of all the factors that make up the program cost. Performance, schedule, quantity, production rate, facilitization, inflation, and risk must all be independently determined to truly weed out all sources of optimism. This comprehensive third-party assessment could be termed an independent program esti-

mate, since it measures and forecasts technical performance, schedule performance, and production readiness to develop the cost estimate. To minimize the expense and management attention that these ICEs will require, they should only be used for the critical program phases where cost-growth risk is high.

To instill cost-estimating discipline, we can go one step beyond the ICE by providing a feedback loop to the services' cost-estimating offices. Historical track records of the independent and government estimating agencies should be monitored to help establish accountability for and credibility of the estimate. The ICE and government cost estimate should be maintained in the DOD cost data bank. These cost estimates can then later be compared to the actual costs reported through the contractor cost data reporting system. These actual costs are already stored in the cost data bank, so half of the work to implement this idea is already done. Cost-estimating accuracy trends could be developed and provided to the services to help them discover and eliminate the optimism in their cost-estimating procedures. The intent of this feedback is to help the services improve their estimates. The big brother, IG syndrome should be avoided. People can learn to beat any system. Remember, our goal is to strive for knowledge, honesty, and realism in our cost estimates.

The above actions by the government will not in themselves be enough to implement Action 6. As was so eloquently stated in the June 29, 1982, Report of the Acquisition Improvement Steering Group:

"Cost growth is best controlled before it happens—after it afflicts a system, we can only measure the impact and attempt to limit it."

Buying-In

I believe the same is true for buying-in. We must develop better ways to influence the contractor's decision to initiate a buy-in. Typically, a buy-in decision is made during development in the anticipation of recovery on the follow-on production contracts. If the development and production efforts were tied closely together, a buy-in would be more difficult. For example, if development and production were conducted under a single contract, as a total package, for a fixed price, a buy-

in would not be possible. Because of the size and risk of DOD programs, we could never hope to negotiate this type of arrangement for a major system. But, I think there are ways (1) to strengthen the cost incentives on current performance, and (2) to incentivize future performance so that a buy-in may not make sense to a contractor.

Many FSD contracts are CPIF with the maximum fee for an underrun limited to 15 percent by a regulatory limit. If this fee were significantly higher, a contractor may be less likely to buy-in and thus pass up a chance for a current high return. I think he would be motivated to set a realistic target cost and strive to achieve the high return associated with an underrun.

**Our goal
is to strive
for knowledge,
honesty, and realism
in our cost
estimates.**

This could be easily implemented. First, the 15 percent limit should be changed (or waived) so that it is not applicable to cost underrun performance. Secondly, the underrun share ratio should allow the contractor at least an equal share of the cost savings due to the overrun. This incentive, by itself, probably will not totally protect against buy-ins, so we need to go further.

Transition to Production

The next area where incentives are needed is to provide a better transition from development to production. One area being worked is to improve the design to unit production cost (DTUPC) incentives so that they are based on actual costs experienced in production (Action No. 22). Additionally, the initiative to Increase Competition (No. 32) could discourage a buy-in by maintaining competition up to and during production. I think the strategy of low-rate initial production (LRIP) as part of the development contract would also discourage buying-in. LRIP would allow us to estimate full production costs directly from actual production experience. This does not

prevent a cost growth, but at least it provides an early warning and a firmer basis for making a full production decision. If the contractor understood that the ultimate full-production decision would be based on the cost results obtained in LRIP, he would be motivated in two ways. First, it would tend to discourage a buy-in since he knows that he will have to actually demonstrate that the production cost goals are achievable before the full production decision is made. Secondly, he would place more emphasis on the producibility costs during the development process in an effort to keep the production costs under control. LRIP also has benefits in competitive situations. For example, if two contractors are competing for a production contract with follow-on, unpriced production options, the LRIP would prevent a contractor from buying-in on the first-year requirements because we have actual cost history to compare with his cost estimate.

Rewarding Performance

Better rewards for good cost performance on production contracts are also needed if we are to meet our cost goals. We can motivate the contractor to improve manufacturing productivity by providing an award fee under the current-year contract. This award would be based on the contractor's efforts to develop and implement efficiency improvements in his manufacturing processes. We should also allow him a share of the savings achieved on future follow-on contracts. This is similar to the value engineering approach used for motivating design efficiencies. If these productivity rewards were, in turn, biased by the ratio of DTUPC to actual unit-production cost, it would discourage a DTUPC buy-in. The best, but often overlooked, feature of these contract incentives is that they do not add any additional costs to the program.

No Simple Answer

The key factor that needs to be kept in mind is that no single action in only one phase of the program will be able to do the cost control job. Many different actions and contract incentives in all phases of the program will need to be used to achieve the desired strategy and results. None of our new, or our old, ways of doing business is a panacea, but each will contribute in some way to overall cost stability. ■

Anne Pearson Cited by Army DCSPER

A longtime DSMC employee, Mrs. Anne Pearson, has received special recognition from the Office of the Army Deputy Chief of Staff for Personnel (DCSPER). She was among six Army employees officially commended for outstanding performance in support of the General Officer Management Office during 1982.

Mrs. Pearson, who is the senior Education Technician in the Office of the Registrar, was specifically commended for her support of Army general officers attending DSMC's Systems Acquisition Management (SAM) Course for General/Flag Officers.

Each year the General Officer Management Office provides the DCSPER with names of individuals who have supported its activities. The 1982 winners were selected from a long list of candidates from throughout the Army.

Lieutenant General M. R. Thurman, the incumbent DCSPER, wrote Brigadier General Benjamin J. Pellegrini, DSMC Commandant:

"Although I recognize that many people at the Defense Systems Management College do great things every day for the Army, one individual who performs yeoman service for the General Officer Management Office deserves special recognition. Please present the attached certificate to Mrs. Anne Pearson with my compliments and thanks."

The citation read as follows:

"Mrs. Anne Pearson is officially commended for her outstanding performance of duty in support of the Army's General Officer Corps in the area of military executive level education and associated administrative support rendered to the Army students attending the Systems Acquisition Management Course. Mrs. Pearson's



Brigadier General Pellegrini presents Mrs. Pearson her DCSPER certificate during a February awards ceremony at the College.

prompt, efficient, and professional service in this sensitive area stands in tribute to her loyalty and dedication."

Mrs. Pearson joined the DSMC staff on June 15, 1971. Only one other staff member can boast of more longevity at the College.

PEOPLE ON THE MOVE



Arnold

Wilbur V. Arnold is a professor of engineering management in the Technical Management Department, School of Systems Acquisition Education. Before joining DSMC, Mr. Arnold was associated for 30 years with Goodyear Aerospace Corporation. He received a B.S.C.E. degree from Case Western Reserve University, and an M.B.A. degree from Kent State University.

Dr. Robert Hayles is a professor of human resources management in the Policy and Organization Management Department, School of Systems Acquisition Education. He is on a 2-year loan from the Office of Naval Research. Dr. Hayles holds a B.A. degree in psychology with a chemistry minor from the University of Kansas, an M.A. degree in social psychology, also from the University of Kansas, and a Ph.D in psychology, University of Colorado.



Hayles



Coffman

Kathryn Coffman is a cataloguer in the Information Center. Her last assignment was at Fort Lee, Va., where she was a reference librarian. Ms. Coffman holds a B.A. degree in history from Mary Washington College, Fredericksburg, Va., and an M.L.S. degree from the University of Maryland.

Lieutenant Colonel William H. Pentz, USA, is an instructor of acquisition management in the Technical Management Department, School of Systems Acquisition Education. His previous assignment was at HQ DARCOM, where he was Chief of the Production Branch, Procurement and Production Directorate. Lieutenant Colonel Pentz received a B.A. degree in economics from the University of Notre Dame, and an M.A. degree in public administration from the University of Oklahoma.



Pentz



Waldron

Frank J. Waldron has joined the College staff as a computer systems analyst in the Acquisition Management Laboratory, School of Systems Acquisition Education. He comes to DSMC from the National Guard Computer Center, Falls Church, Va.

Staff losses:

Lieutenant Colonel William J. Smith, USAF, Director, Program Management Course, to Norton AFB, Calif.

Lieutenant (j.g.) Carolyn A. L. Jamison, USN, Policy and Organization Management Department, to Naval Electronic Command, Washington Navy Yard.

PO1 Keno Powell, USN, Duplicating Division, to Norfolk, Va.

Sergeant Carmen Hughes, USA, Supply and Procurement Division.

Janet Mills, Office of the Registrar.

Ruth Crismond, Business Management Department.

"Reform 88"

A Program to Improve Government Operations

David D. Acker

(Editor's Note: This is the second article in the series by Professor Acker of our research staff. The first article appeared in the January/February issue of the *Program Manager*.)

One of the principal goals of the "Reform 88" program is to streamline the operations of the federal government so that it functions in a more businesslike manner. Edwin Meese III, counselor to the President, and chairman pro tem of the Cabinet Council on Management and Administration, indicated at the start of this program last September that meeting the objectives of the program is "one of the highest priorities of this administration."

Programs of this nature have failed in the past. The government has continued to grow, to cost more, to become more complex, and to take longer to get things done. Of course the members of the Reagan administration recognize that there were failures in the past. But this did not deter them from trying again. After each new or changed policy resulting from this program is announced, the Cabinet Council intends to keep tabs on the department and agency actions to ensure proper implementation of the policy.

It is the intent of the White House to automate some of the data flow presenting "progress-to-date" in the implementation of the policies—devised by teams supporting the Cabinet Council—and approved by the president. Unfortunately, the task will take time—perhaps as many as 6 years.

There will be some procurement projects under Reform 88. The Regulatory Reform project headed by Vice President George Bush will be one of them.

The Cabinet Council on Management and Administration expects to receive hundreds of recommendations for action from the Presidential Private Sector Survey on Cost Control which was completed last year. The group that conducted the survey has been

referred to as the Grace Commission because it was chaired by J. Peter Grace, chairman of W. R. Grace Company. In addition to the recommendations of the Grace Commission, department and agency "hot line" operators are receiving calls every day urging investigators to follow up on leads covering waste and illegal practices in the government. More than 40 percent of the calls being received appear to have some substance for audit or investigation, and about 30 percent involve an allegation of wrongdoing.

The General Accounting Office (GAO), which mans the oldest hot line, receives about 70 calls on the hot line every working day. In addition to hot-line follow up, the GAO has made vulnerability assessments of department and agency programs during the past several years. The objective of these assessments has been to determine whether the departments or agencies have adequate accounting and operational or management controls to prevent or discourage further waste, fraud, or abuse. As used here, waste is the incurring of unnecessary costs as a result of deficient practices, systems, or controls. Fraud is the obtaining of something of value, unlawfully, through willful misrepresentation. Abuse involves a variety of excessive services or program violations, and improper practices not involving prosecutable fraud. Experience has shown that the loss caused by waste is far greater than the loss attributable to fraud.

Joseph Wright, deputy director of the Office of Management and Budget (OMB), believes the government needs a better financial management and accounting system. He points out that we do not have any automated bill-collection system in the government. The inspectors general have been upgraded in importance; however, for the most part, the IGs do manual auditing. Wright also points out that the government doesn't have a good management information system.

Before the information available at any given time is compiled and moved up the organizational line to the president, it is out of date.

The goal of Reform 88 is to seek inter-agency improvements. Some of the changes that could be made quickly, such as issuing cash-flow quarterly reports, have been made. The tough ones are still to be dealt with. It is anticipated that there will be resistance to some of the changes resulting from the Reform 88 program. However, if the program continues to receive top-level attention, it is anticipated that the people in the organizations affected will be responsible to the new or revised policies.

At this time, the momentum of the Reform 88 program favors accomplishment of the objectives established by the Reagan administration in September 1982; i.e., to implement an administrative on-line communication system between the White House and the Cabinet departments, to review and trim central agency regulations, to implement cost-saving projects, to inventory agency management systems and promote the sharing of the systems considered to be good, and to develop both short- and long-range goals for improving the management of government operations. Meese said at the start of the Reform 88 program that this administration would like to leave the American people "a federal government operating in a businesslike manner." This is a noble objective we all should support.

More Cards and Questions

We recently sent cards to all our readers asking you to verify that you want to continue receiving *Program Manager*. The card also asked for status information and whether you had attended a DSMC course. If you have not returned the card, please do so. If you did not receive a card, write or call and we will send you one.

Program Manager